PHASE **2**

Washington State
School Seismic Safety Assessments Project

MORTON ELEMENTARY SCHOOL MAIN BUILDING

Morton School District

SEISMIC UPGRADES CONCEPT DESIGN REPORT

June 2021

PREPARED FOR

PREPARED BY

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WASHINGTON STATE SCHOOL SEISMIC SAFETY ASSESSMENTS PROJECT

SEISMIC UPGRADES CONCEPT DESIGN REPORT

Morton Elementary School – Main Building

Morton School District

June 2021

Prepared for:

State of Washington
Department of Natural Resources and Office of Superintendent of Public Instruction

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EXECUTIVE SUMMARY

This report documents the findings of a seismic evaluation of the Morton Elementary School main building in Morton, Washington. The elementary school is a two-story, rectangular, 12,360-square-foot building, constructed in 1948. The roof diaphragm is constructed with straight sheathing and wood purlins supported by exterior brick masonry walls, interior stud walls, and interior wood columns. The first floor is a straight-sheathed wood diaphragm with wood joists and steel beams supported by exterior concrete walls, interior wood walls, and interior steel columns. The ground floor is slab on grade with spread footings supporting interior steel columns and wall footings supporting the concrete walls. The school was renovated in 1987, which removed the play areas to add additional rooms. The building currently features a cafeteria, stage, library, mechanical room, classrooms, and various administrative spaces.

WRK Engineers performed a Tier 1 screening in accordance with the ASCE 41-17 standard *Seismic Evaluation and Retrofit of Existing Buildings*. The evaluation included field observations and review of record drawings to verify the existing construction. The structural seismic evaluation indicated that the building has multiple seismic deficiencies; the most susceptible ones being lateral capacity of the diaphragms and shear walls, out-of-plane wall anchorage and bracing, continuous diaphragm cross-ties, and redundancy of shear walls.

Conceptual seismic upgrade recommendations for the structural systems are provided to improve the performance of the building to meet the Life Safety structural performance objective criteria of ASCE 41-17. Sketches for the concept-level seismic upgrades are provided in Appendix B. The structural upgrades include strongbacking of exterior walls, out-of-plane wall anchorage, addition of plywood diaphragms, addition of plywood to existing stud walls, addition of concrete and masonry shear walls, addition of footings, and addition of collectors to the diaphragm. The recommendations for nonstructural upgrades are to brace tall and narrow contents, brace hazardous material piping, brace fall prone contents, and to provide flexible coupling hazardous material piping joints. It is also recommended to further investigate the unreinforced masonry at stair enclosures, masonry veneer stability, and stair connections.

An opinion of probable construction costs is provided in Appendix C. It is our opinion that the total cost (construction costs plus soft costs) to upgrade the structure would range between \$4.45M and \$8.35M with the baseline estimated total cost being \$5.57M. Note however that this estimated cost and cost range could be significantly higher if the presence of liquefiable soils is discovered and requires ground improvements on the Morton Elementary School campus to mitigate post-earthquake liquefaction settlement. A detailed geotechnical investigation is also recommended prior to doing a seismic upgrade design project.

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Table of Contents

Appendix List

Figure List

Table List

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Acronyms

AACE	Association for the Advancement of Cost Engineering
ADA	Americans with Disabilities Act
ASCE	American Society of Civil Engineers
A-E	Architect-Engineer
BPOE	Basic Performance Objective for Existing Buildings
BSE	Basic Safety Earthquake
CMU	Concrete Masonry Unit
CP	Collapse Prevention
DNR	Department of Natural Resources
DCR	Demand-to-Capacity Ratio
EERI	Earthquake Engineering Research Institute
EPAT	EERI Earthquake Performance Assessment Tool
FEMA	Federal Emergency Management Agency
FRP	Fiber-Reinforced Plastic
GWB	Gypsum Wallboard
GC/CM	General Contractor / Construction Manager
IBC	International Building Code
ICOS	Information and Condition of Schools
IEBC	International Existing Building Code
IO	Immediate Occupancy
LS	Life Safety
MCE	Maximum Considered Earthquake
MEP	Mechanical/Electrical/Plumbing
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
OSPI	Office of Superintendent of Public Instruction
PBEE	Performance-Based Earthquake Engineering
PR	Position Retention
ROM	Rough Order-of-Magnitude
SSSSC	School Seismic Safety Steering Committee
UBC	Uniform Building Code
URM	Unreinforced Masonry
USGS	United States Geological Survey
WF	Wide Flange
WGS	Washington Geological Survey
WSSSSAP	Washington State School Seismic Safety Assessments Project

Reference List

Codes and References

2018 IBC, *2018 International Building Code,* prepared by the International Code Council, Washington, D.C.

AACE International Recommended Practice No. 56R-08, 2020, *Cost Estimate Classification System*, prepared by the Association for the Advancement of Cost Engineering International, Fairmont, West Virginia.

ASCE 7-16, 2017, *Minimum Design Loads for Buildings and Other Structures*, prepared by the Structural Engineering Institute of the American Society of Civil Engineers, Reston, Virginia.

ASCE 41-17, 2017, *Seismic Evaluation and Retrofit of Existing Buildings*, prepared by the Structural Engineering Institute of the American Society of Civil Engineers, Reston, Virginia.

FEMA E-74, 2011, *Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide*, prepared by Applied Technology Council, Redwood City, California.

Structural Engineers of Northern California, 2017, Earthquake Performance Rating System ASCE 41-13 Translation Procedure: The Buildings Ratings Committee, a sub-committee of the Existing Buildings Committee of The Structural Engineers Association of Northern California.

Structural Engineers of Northern California, 2015, Earthquake Performance Rating System User's Guide: The Buildings Ratings Committee, a sub-committee of the Existing Buildings Committee of The Structural Engineers Association of Northern California.

Drawings

Mock & Morrison, March 9, 1948, existing drawings titled "Grade School Morton, Morton, Washington School District #214 Eastern Lewis County" Lewis County, Washington (Morton Elementary School Main Building, "Main Building")

1.0 Introduction

1.1 Background

In 2018-2019, the Washington Geological Survey (WGS), a division of the Department of Natural Resources (DNR), led a Washington State School Seismic Safety Assessments Project (WSSSSAP) that seismically and geologically screened 222 school buildings and 5 fire stations across Washington State to better understand the current level of seismic risk of Washington State's public-school buildings. This first phase of the WSSSSAP was executed with the help of Washington State's Office of Superintendent of Public Instruction (OSPI) and Reid Middleton, along with their team of structural engineers, architects, and cost estimators.

Building upon the success of Phase 1, WGS, OSPI, and Reid Middleton's team embarked on Phase 2 of this project to seismically and geologically screen another 339 school buildings and 2 fire stations, mostly located in the high-seismic risk regions of Washington State. Similar to Phase 1, the two main components of Phase 2 of this seismic safety assessments project are: (1) geologic site characterization, and (2) the seismic assessment of buildings. As a part of the seismic assessments, Tier 1 screening of structural systems and nonstructural assessments were performed in accordance with the American Society of Civil Engineers' (ASCE) Standard 41-17 *Seismic Evaluation and Retrofit of Existing Buildings*. Concept-level seismic upgrades were developed to address the identified deficiencies of a select number of school buildings to evaluate seismic upgrade strategies, feasibilities, and implementation costs.

Seventeen school buildings were selected in consultation with WGS and OSPI to receive concept-level seismic upgrade designs utilizing the ASCE 41 Tier 1 evaluation results. This report documents the concept-level seismic upgrade design for one of those school buildings. The concept-level seismic upgrades will include structural and nonstructural seismic upgrade recommendations, with concept-level sketches and rough order-of-magnitude (ROM) construction costs determined for each building. The 17 school buildings were selected from the list of schools with the intent of representing a variety of regions, building uses, construction eras, and construction materials.

The overall goal of the project is to provide a better understanding of the current seismic risk of our state's K-12 school buildings and what needs to be done to improve the buildings in accordance with ASCE 41 to meet seismic performance objectives.

The seismic evaluation consists of a Tier 1 screening for the structural systems performed in accordance with ASCE 41-17.

1.2 Scope of Services

The project is being performed in several distinct and overlapping phases of work. The scope of this report is as listed in the following sections.

1.2.1 Information Review

1. Project Research: Reid Middleton and their project team researched available school building records, such as relevant site data and record drawings, in advance of the field investigations. This research included searching school building records and contacting the districts and/or the Office of Superintendent of Public Instruction (OSPI) to obtain building plans, seismic reports, condition reports, or related construction information useful for the project.

2. Site Geologic Data: Site geological data provided by the WGS, including site shear wave velocities, was utilized to determine the project Site Class in accordance with ASCE 41, which is included in the Tier 1 checklists and concept-level seismic upgrades design work.

1.2.2 Field Investigations

1. Field Investigations: Each of the identified buildings was visited to observe the building's age, condition, configuration, and structural systems for the purposes of the ASCE 41 Tier 1 seismic evaluations. This task included confirmation of general information in building records or layout drawings and visual observation of the structural condition of the facilities. Engineer field reports, notes, photographs, and videos of the facilities were prepared and utilized to record and document information gathered in the field investigation work.

2. Limitations Due to Access: Field observation efforts were limited to areas and building elements that were readily observable and safely accessible. Observations requiring access to confined spaces, potential hazardous material exposure, access by unsecured ladder, work around energized equipment or mechanical hazards, access to areas requiring Occupational Safety and Health Administration (OSHA) fall-protection, steep or unstable slopes, deteriorated structural assemblies, or other conditions deemed potentially unsafe by the engineer were not performed. Removal of finishes (e.g., gypsum board, lath and plaster, brick veneer, roofing materials) for access to concealed conditions or to expose elements that could not otherwise be visually observed and assessed was not performed. Material testing or sampling was not performed. The ASCE 41 checklist items that were not documented due to access limitations are noted.

1.2.3 Seismic Evaluations and Conceptual Upgrades Design

1. Seismic Evaluations: Limited seismic assessments of the structural and nonstructural systems of the school buildings were performed in accordance with ASCE 41-17 Tier 1 Evaluation Procedures.

2. Conceptual Upgrades Design: Further seismic evaluation work was performed to provide concept-level seismic retrofits and/or upgrade designs for the selected school buildings based on the results of the Tier 1 seismic evaluations. The concept-level seismic upgrades design work included narrative descriptions of proposed seismic retrofits and/or

upgrade schemes and concept sketches depicting the extent and type of recommended structural upgrades.

3. Architectural Review: The seismic upgrade concept developed by the structural engineers was reviewed by Dykeman Architects for general guidance and consideration of the architectural aspects of the seismic upgrade. The architects discussed the seismic upgrade concepts with the structural engineer and reviewed existing drawings that were available, pictures taken during the engineer's field investigations, and the ASCE 41 Tier 1 Screening reports. However, field visits by the architect and meetings with the school district and facilities personnel to discuss phasing and programming requirements were not included in the project scope of work. The architectural considerations are discussed in Section 4.4 Nonstructural Recommendations and Considerations. These conceptual designs were reviewed with high-level recommendations. Future planning for seismic improvements should include further review with a design team.

4. Cost Estimating: Through the concept-level seismic upgrades report process, ProDims, LLC, provided opinions of probable construction costs for the concept-level seismic upgrade designs for the selected school buildings. These concept-level seismic upgrade designs and the associated opinions of probable construction costs are intended to be representative samples that can be extrapolated to estimate the overall capital needs of seismically upgrading Washington State schools.

1.2.4 Reporting and Documentation

1. Conceptual Upgrade Design Reports: Buildings that were selected to receive a conceptual upgrade design will have a report prepared that will include an introduction summarizing the overall findings and recommendations, along with individual sections documenting each building's seismic evaluation, list of deficiencies, conceptual seismic upgrade sketches and opinions of probable construction costs.

2. Building Photography: Photos were taken of each building during on-site walkthroughs to document the existing building configurations, conditions, and structural systems. These are available upon request through DNR/WGS.

3. Existing Drawings: Select and available existing drawings and other information were collected during the evaluation process. These are available upon request through DNR/WGS.

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2.0 Seismic Evaluation Procedures and Criteria

2.1 ASCE 41 Seismic Evaluation and Retrofit Overview

The current standard for seismic evaluation and retrofit (upgrades) of existing buildings is ASCE 41-17. ASCE 41 provides screening and evaluation procedures used to identify potential seismic deficiencies that may require further investigation or hazard mitigation. It presents a three-tiered review process, implemented by first following a series of predefined checklists and "quick check" structural calculations. Each successive tier is designed to perform an increasingly refined evaluation procedure for seismic deficiencies identified in previous tiers in the process. The flow chart in Figure 2.1 illustrates the evaluation process.

TIER 1 – Screening Phase
- Checklists of evaluation statements to quickly identify potential deficiencies
- Requires field investigation and/or review of record drawings
- Analysis limited to "Quick Checks" of global elements
- May proceed to Tier 2, Tier 3, or rehabilitation design if deficiencies are identified

TIER 2 – Evaluation Phase
- "Full Building" or "Deficiency Only" evaluation
- Address all Tier 1 seismic deficiencies
- Analysis more refined than Tier 1, but limited to simplified linear procedures
- Identify buildings not requiring rehabilitation

TIER 3 – Detailed Evaluation Phase
- Component-based evaluation of entire building using reduced ASCE 41 forces
- Advanced analytical procedures available if Tier 1 and/or Tier 2 evaluations are judged to be overly conservative
- Complex analysis procedures may result in construction savings equal to many times their cost

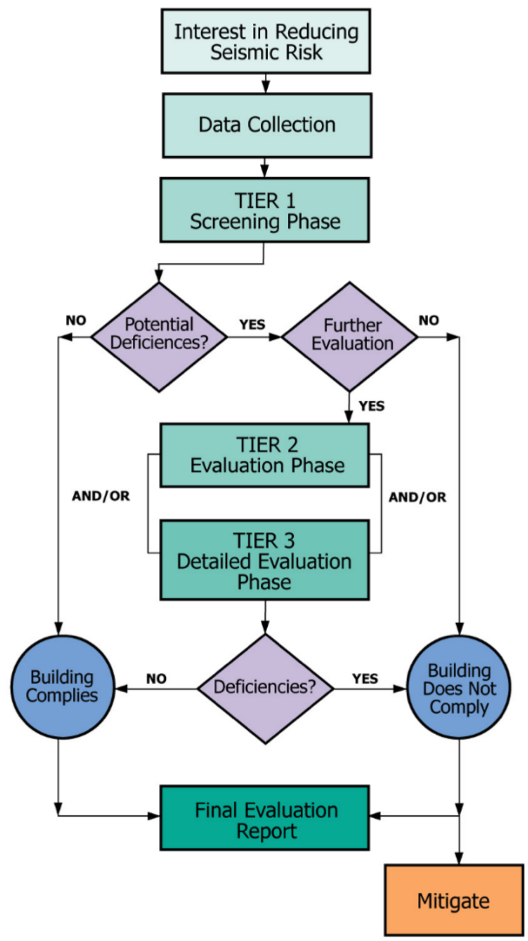

Figure 2-1. Flow Chart and Description of ASCE 41 Seismic Evaluation Procedure.

The Tier 1 checklists in ASCE 41 are specific to each common building type and contain seismic evaluation statements based on observed structural damage in past earthquakes. These checklists screen for potential seismic deficiencies by examining the lateral-force-resisting systems and details of construction that have historically caused poor seismic performance in similar buildings. Tier 1 screenings include basic "Quick Check" analyses for primary components of the lateral system. Tier 1 screenings also include prescriptive checks for proper seismic detailing of connections, diaphragm spans and continuity, and overall system configuration.

Tier 2 evaluations then follow with more-detailed structural and seismic calculations and assessments to either confirm the potential deficiencies identified in the Tier 1 review or demonstrate their adequacy. A Tier 3 evaluation involves an even more detailed analysis and advanced structural and seismic computations to review each structural component's seismic demand and capacity. A Tier 3 evaluation is similar in scope and complexity to the types of analyses often required to design a new building in accordance with the International Building Code (IBC), with a comprehensive analysis aimed at evaluating each component's seismic performance. Generally, Tier 3 evaluations are not practical for typical and regular-type buildings due to the rigorous and complicated calculations and procedures. As indicated in the Scope of Services, this evaluation included a Tier 1 screening of the structural systems.

2.2 Seismic Evaluation and Retrofit Criteria

Performance-Based Earthquake Engineering (PBEE) can be defined as the engineering of a structure to resist different levels of earthquake demand in order to meet the needs and performance objectives of building owners and other stakeholders. ASCE 41 employs a PBEE design methodology that allows building owners, design professionals, and the local building code authorities to establish seismic hazard levels and performance goals for individual buildings.

2.2.1 Site Class Definition

The building site class definition quantifies the site soil's propensity to amplify or attenuate earthquake ground motion propagating from underlying rock. Site class has a direct impact on the seismic design forces utilized to design and evaluate a structure. There are six distinct site classes defined in ASCE 7-16, Site Class A through Site Class F, that range from hard rock to soils that fail such as liquefiable soils. Buildings located on soft or loose soils will typically sustain more damage than similar buildings located on stiff soils or rock, all other things being equal. The Washington State Department of Natural Resources measured the time-averaged shear-wave velocity at each site to 30 meters (100 feet) below the ground surface, Vs30. This measured shear-wave velocity was used to determine the site class. The site class for this building was determined to be **Site Class C**.

2.2.2 Morton Elementary School Seismicity

Seismic hazards for the United States have been quantified by the United States Geological Survey (USGS). The information has been used to create seismic hazard maps, which are currently used in building codes to determine the design-level earthquake magnitudes for building design.

The Level of Seismicity is categorized as Very Low, Low, Moderate, or High based on the probabilistic ground accelerations. Ground accelerations and mass generate inertial (seismic) forces within a building (Force = mass x acceleration). Ground acceleration therefore is the parameter that classifies the level of seismicity. From geographic region to region, as the ground accelerations increase, so does the level of seismicity (from low to high). Where this building is located, the design short-period spectral acceleration, S_{DS}, is 1.053 g, and the design 1-second period spectral acceleration, S_{D1}, is 0.466 g. Based on ASCE 41 Table 2-4, the Level of Seismicity for this building is classified as **High**.

The ASCE 41 Basic Performance Objective for Existing Buildings (BPOE) makes use of the Basic Safety Earthquake – 1E (BSE-1E) seismic hazard level and the Basic Safety Earthquake – 2E (BSE-2E). The BSE-1E earthquake is defined by ASCE 41 as the probabilistic ground motion with a 20 percent probability of exceedance in 50 years, or otherwise characterized as a ground motion acceleration with a probabilistic 225-year return period. The BSE-2E earthquake is defined by ASCE 41 as the probabilistic ground motion with a 5 percent probability of exceedance in 50 years, or otherwise characterized as a ground motion acceleration with a probabilistic 975-year return period. The BSE-2N seismic hazard level is the Maximum Considered Earthquake (MCE) ground motion used in current codes for the design of new buildings and is also used in ASCE 41 to classify the Level of Seismicity for a building. The BSE-2N has a statistical ground motion acceleration with 2 percent probability of exceedance in 50 years, or otherwise characterized as a ground motion acceleration with a probabilistic 2,475-year return period.

Table 2.2.1-1 provides the spectral accelerations for the 225-year, 975-year, and 2,475-year return interval events specific to Morton Elementary School that are considered in this study.

Table 2.2.1-1. Spectral Acceleration Parameters (Site Class C).

BSE-1E 20%/50 (225-year) Event		BSE-1N 2/3 of 2,475-year Event		BSE-2E 5%/50 (975-year) Event		BSE-2N 2%/50 (2,475-year) Event	
0.2 Seconds	0.601 g	0.2 Seconds	1.053 g	0.2 Seconds	1.175 g	0.2 Seconds	1.579 g
1.0 Seconds	0.218 g	1.0 Seconds	0.466 g	1.0 Seconds	0.507 g	1.0 Seconds	0.699 g

2.2.3 Morton Elementary School Structural Performance Objective

The school building is an Educational Group E occupancy (Risk Category III) structure and has not been identified as a critical structure requiring immediate use following an earthquake. However, Risk Category III buildings are structures that represent a substantial hazard to human life in the event of failure. According to ASCE 41, the BPOE for Risk Category III structures is the Damage Control structural performance level at the BSE-1E seismic hazard level and the Limited Safety structural performance level at the BSE-2E seismic hazard level. The ASCE 41 Tier 1 evaluations were conducted in accordance with ASCE 41 requirements and ASCE 41 seismic performance levels. Concept-level upgrades were developed for the **Life Safety** structural performance level at the **BSE-1N** seismic hazard level in accordance with DNR direction, the project scope of work, and the project legislative language.

At the Life-Safety performance level, the building may sustain damage while still protecting occupants from life-threatening injuries and allowing occupants to exit the building. Structural and nonstructural components may be extensively damaged, but some margin against the onset of partial or total collapse remains. Injuries to occupants or persons in the immediate vicinity may occur during an earthquake; however, the overall risk of life-threatening injury as a result of structural damage is anticipated to be low. Repairs may be required before reoccupying the building, and, in some cases, repairs may be economically unfeasible.

Knowledge Factor

A knowledge factor, *k*, is an ASCE 41 prescribed factor that is used to account for uncertainty in the as-built data considering the selected Performance Objective and data collection processes (availability of existing drawings, visual observation, and level of materials testing). No in-situ testing of building materials was performed; however, some material properties and existing construction information were provided in the existing record drawings. If the concept design is developed further, additional materials tests and site investigations will be required to substantiate assumptions about the existing framing systems.

ASCE 41 Classified Building Type

Use of ASCE 41 for seismic evaluations requires buildings to be classified from a group of common building types historically defined in previous seismic evaluation standards (ATC-14, FEMA 310, and ASCE 31-03). The school is classified in ASCE 41 Table 3-1 as an unreinforced masonry bearing wall with flexible diaphragms, **URM,** at the top floor and a concrete shear wall with flexible diaphragms, **C2a,** at the ground floor. Unreinforced masonry bearing wall buildings (**URM**) include those that have perimeter bearing walls constructed of unreinforced masonry with flexible diaphragms relative to the walls. Concrete Shear Wall buildings (**C2a**) include those that resist seismic forces through cast-in-place concrete shear walls with flexible diaphragms.

2.3 Report Limitations

The professional services described in this report were performed based on available record drawing information and limited visual observation of the structure. No other warranty is made as to the professional advice included in this report. This report provides an overview of the seismic evaluation results and does not address programming and planning issues. This report has been prepared for the exclusive use of DNR/WGS and is not intended for use by other parties, as it may not contain sufficient information for purposes of other parties or their uses.

3.0 Building Description & Seismic Evaluation Findings

3.1 Building Overview

3.1.1 Building Description

Original Year Built: 1948
Building Code: 1946 UBC

Number of Stories: 1
Floor Area: 25,200 SF

FEMA Building Type: URM & C2a
ASCE 41 Level of Seismicity: High
Site Class: C

The Morton Elementary School Main building is located on a flat site at the south-central area of the Morton Elementary School complex. The building is rectangular in plan and has a footprint of 206 feet by 60 feet. The main building, constructed in 1948, consists of a two-story masonry and concrete building. A remodel in 1987 removed play areas and added classrooms, administrative rooms, and a library. The building currently contains a cafeteria, stage, library, mechanical room, classrooms, and various administrative spaces.

The roof system consists of straight sheathing over wood purlins. The purlins span between wood beams supported by columns and brick masonry walls. The first floor diaphragm consists of straight sheathing over wood joists. The joists span between the steel beams, concrete walls, and stud walls. The steel beams are supported by steel columns and concrete walls. The ground floor consists of a concrete slab. The foundation consists of conventional concrete wall footings and spread footings.

The lateral system consists of flexible diaphragms, unreinforced masonry shear walls, and concrete shear walls. The roof diaphragm spans between exterior unreinforced masonry walls. The first floor wood diaphragm spans between concrete walls with wall footings.

3.1.2 Building Use

The Main building has a lunchroom, kitchen, stage, library, mechanical room, classrooms, staff offices, and storage rooms.

3.1.3 Structural System

Table 3.1.3-1. Structural System Descriptions.

Structural System	Description
Structural Roof	The roof system is composed of built-up wood trusses and purlins.
Structural Floor	The floor system is composed of wood joists and straight sheathing.
Foundations	The walls and columns are supported by spread footings.
Gravity System	The gravity system consists of steel beams and columns, wood joists, concrete walls, brick masonry walls, and wood stud walls.
Lateral System	Concrete shear walls resist the forces in the longitudinal and transverse directions.

3.1.4 Structural System Visual Condition

Table 3.1.4-1. Structural System Condition Descriptions.

Structural System	Description
Structural Roof	No visible signs of corrosion, damage, or deterioration.
Structural Floor	No visible signs of corrosion, damage, or deterioration.
Foundations	Unknown.
Gravity System	Cracking observed on interior wall at stairwell.
Lateral System	No visible signs of corrosion, damage, or deterioration.

3.2 Seismic Evaluation Findings

3.2.1 Structural Seismic Deficiencies

The structural seismic deficiencies identified during the Tier 1 evaluation are summarized below. Commentary for each deficiency is provided based on this evaluation.

Table 3.2.1-1. Identified Structural Seismic Deficiencies Based on Tier 1 Checklists.

Deficiency	Description
Shear Stress Check	Per the Quick Check procedure, the shear stress of both the concrete and unreinforced masonry shear walls is noncompliant. Further investigation should be performed prior to retrofit. Lateral system strengthening, such as shotcreting walls or adding new shear walls or braced frames may be appropriate to mitigate seismic risk.
Wall Anchorage at Flexible Diaphragms	This evaluation item is non-compliant due to existing drawings. The addition of tension ties, blocking, strapping, and diaphragm nailing may be appropriate to mitigate seismic risk.
Proportions	A quick calculation indicates the top story does not comply. Further investigation should be performed prior to retrofit. Unreinforced masonry out-of-plane strengthening, such as a steel strongback system, is likely required.
Stiffness of Wall Anchors	The masonry walls do not have viable wall anchors. The joist bridging that anchors to the wall is only clipped to the joists and is not sufficiently attached to be a rigid out-of-plane wall anchor connection. Replacement of anchors or the addition of new post-installed anchors may be appropriate to mitigate seismic risk.
Foundation Dowels	No wall reinforcement is doweled into the foundation. A direct, structural connection, such as fiber-reinforced plastic (FRP), between the walls and the foundation should be provided to mitigate seismic risk.
Cross-ties	There are no continuous cross-ties between diaphragm chords. The addition of new cross-ties between diaphragm chords or the addition of strap plates to connect existing framing members together may be appropriate to mitigate seismic risk.
Straight Sheathing	Straight-sheathed diaphragms have aspect ratios greater than 2-to-1. Diaphragm strengthening, such as the addition of plywood sheathing, may be appropriate.
Spans	Diaphragms are straight-sheathed. Installation of plywood sheathing may be appropriate.

3.2.2 Structural Checklist Items Marked as "U"nknown

Where building structural component seismic adequacy was unknown due to lack of available information or limited observation, the structural checklist items were marked as "unknown". These items require further investigation if definitive determination of compliance or noncompliance is desired. The unknown structural checklist items identified during the Tier 1 evaluation are summarized below. Commentary for each unknown item is provided based on the evaluation.

Table 3.2.2-1. Identified Structural Checklist Items Marked as Unknown.

Deficiency	Description
Girder-Column Connection	This evaluation item is unknown and likely non-compliant due to the building's age, inadequate drawings, and no access to verify. Further investigation should be performed.
Load Path	Drawings provided are incomplete, and a complete, viable load path could not be visually verified. This evaluation item is likely non-compliant due to the building's age. This item requires further investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.
Redundancy	Incomplete existing drawings and inadequate access to verify. Further investigation should be performed.
Slope Failure	Requires further investigation by a licensed geotechnical engineer to determine susceptibility to slope failure
Surface Fault Rupture	Requires further investigation by a licensed geotechnical engineer to determine whether site is near locations of expected surface fault ruptures.
Complete Frames	This evaluation item is unknown and likely non-compliant due to the building's age, and it could not be visually verified. This item requires further investigation to make a final determination and to develop a mitigation recommendation, if necessary.
Reinforcing Steel	This evaluation item is unknown due to the incomplete construction drawings. This item requires further investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary
Transfer to Shear Walls	This evaluation item is unknown due to the incomplete construction drawings. This item requires further investigation to make a final determination on its compliance. Direct, structural connections, such as post-installed anchors, between the diaphragm and the concrete shear walls may be required
Deflection Compatibility	This evaluation item is unknown and likely non-compliant due to the building's age, and it could not be visually verified. This item requires further investigation to make a final determination and to develop a mitigation recommendation, if necessary.

3.2.3 Nonstructural Seismic Deficiencies

Table 3.2.3-1 summarizes the seismic deficiencies in the nonstructural systems. The Tier 1 screening checklists are provided in Appendix A.

Table 3.2.3-1. Identified Nonstructural Seismic Deficiencies based on Tier 1 Checklists.

Deficiency	Description
Tall Narrow Contents	Anchorage is required for tall narrow contents more than six feet high to provide overturning restraint.
Hazardous Material Distribution	Piping and ductwork did not appear to be adequately braced. Bracing for all hazardous material piping and ductwork may be appropriate to mitigate seismic risk.
Fall Prone Contents	Bookshelves appear to support heavy items that do not appear well secured. Heavy items on upper shelves should be restrained by netting or cabling to mitigate seismic risk.
Flexible Couplings	It appears that the piping has fixed connections. Installation of flexible couplings may be appropriate to mitigate seismic risk.
Stair Enclosures	It appears that the 12-to-1 height-to-thickness ratio is exceeded on the second floor. Bracing for the wall may be appropriate to mitigate seismic risk.

3.2.4 Nonstructural Checklist Items Marked as "U"nknown

Where building nonstructural component seismic adequacy was unknown due to lack of available information or limited observation, the nonstructural checklist items were marked as "unknown". These items require further investigation if definitive determination of compliance or noncompliance is desired. The unknown nonstructural checklist items identified during the Tier 1 evaluation are summarized below. Commentary for each unknown item is provided based on the evaluation.

Some nonstructural deficiencies may be able to be mitigated by school district staff. Other nonstructural components that require substantial mitigation may be more appropriately included in a long-term mitigation strategy. Some typical conceptual details for the seismic upgrade of nonstructural components can be found in the FEMA E-74 Excerpts appendix.

Table 3.2.4-1. Identified Nonstructural Checklist Items Marked as Unknown.

Deficiency	Description
Ties	No existing drawings and inadequate access to verify. Further investigation should be performed.

Table 3.2.4-1. Identified Nonstructural Checklist Items Marked as Unknown.

Deficiency	Description
Shelf Angles	No existing drawings and inadequate access to verify. Further investigation should be performed.
Weakened Planes	No existing drawings and inadequate access to verify. Further investigation should be performed.
Stair Details	No existing drawings and inadequate access to verify. Further investigation should be performed.

4.0 Recommendations and Considerations

4.1 Seismic-Structural Upgrade Recommendations

Concept-level seismic upgrade recommendations to improve the lateral-force-resisting system were developed. The sketches in Appendix B depict the concept-level structural upgrade recommendations outlined in this section. The following concept recommendations are intended to address the structural deficiencies noted in Table 3.2.1-1. This concept-level seismic upgrade design represents just one of several alternative seismic upgrade design solutions and is based on preliminary seismic evaluation and analysis results. Final analysis and design for seismic upgrades must include a more detailed seismic evaluation of the building in its present or future configuration. Proposed seismic upgrades include the following.

4.1.1 Roof Diaphragm Sheathing

The shear capacity of the straight sheathing is insufficient to transfer lateral load to the shear walls. It is recommended that structural plywood sheathing be added to the existing diaphragm. It is also recommended to provide continuous chord elements at the diaphragm to mitigate seismic risk.

4.1.2 Strongbacking of Exterior Masonry

The exterior walls consist of 17-inch unreinforced masonry. The maximum allowable span for the unreinforced masonry is exceeded. It is recommended to stiffen these walls for out-of-plane seismic forces by adding strongbacks at piers. It is recommended to connect the strongbacks to the roof and first floor diaphragm with strapping and blocking to mitigate seismic risk.

4.1.3 New Shear Walls with Collectors and Foundations

The existing walls are inadequate to resist the expected seismic demands. It is recommended to add plywood to existing stud walls, 8-inch concrete shear walls, and masonry shear walls to transfer the lateral load and provide shear wall redundancy. It is recommended to pour new foundations under the masonry shear walls. It is recommended to add collectors spanning the length of the roof and first floor diaphragms to transfer load to the new shear walls.

4.2 Foundations and Geotechnical Considerations

A detailed geotechnical analysis of the site soils was not included in the scope of this study. As a result, the geotechnical seismic effects on the existing building and its foundations, such as the presence of liquefiable soils and allowable soil bearing pressures, are unknown at this time. However, although the Vs30 measurement for this site is 455 m/s (1492 ft/s) and within Site Class C parameters (and not normally associated with liquefiable soils), based on State of Washington liquefaction mapping, this building is located on soils classified with a moderate to high susceptibility of liquefaction. This discrepancy should be further investigated and reviewed by a licensed geotechnical engineer.

Liquefaction is the tendency of certain soils to saturate and lose strength during strong earthquake shaking, causing it to flow and deform similar to a liquid. Liquefaction, when it occurs, drastically decreases the soil bearing capacity and tends to lead to large differential settlement of soil across a building's footprint. Liquefaction can also cause soils to spread laterally and can dramatically affect a building's response to earthquake motions, all of which can significantly compromise the overall stability of the building and possibly lead to isolated or widespread collapse in extreme cases. Existing foundations damaged as a result of liquefiable soils also make the building much more difficult to repair after an earthquake.

Buildings that are not founded on a raft foundation or deep foundation system (such as grade beams and piles), and those with conventional strip footings and isolated spread footings that are not interconnected well with tie beams, are especially vulnerable to liquefiable soils. Mitigation techniques used to improve structures in liquefiable soils vary based on the type and amount of liquefiable soils and may include ground improvements to densify the soil (aggregate piers, compaction piling, jet grouting), installation of deep foundations (pin piling, augercast piling, micro-piling), and installation of tie beams between existing footings.

The existing Morton Elementary Main Building is founded on shallow foundations. The soil capacity to resist seismic demands is unknown at this time. It is recommended that a detailed geotechnical study and investigation be completed on the building site to determine the nature of the liquefaction hazard and the characteristics of the site soils. Foundation mitigation and ground improvement may be required and the recommended geotechnical investigation could have a major impact on the scope of work required for seismic retrofit.

4.3 Tsunami Considerations

The building is not located in a tsunami inundation zone according to Washington State Department of Natural Resources tsunami inundation mapping. It is not necessary to consider tsunamis when planning seismic upgrades to this building.

4.4 Nonstructural Recommendations and Considerations

Table 3.2.3-1 identifies nonstructural deficiencies that do not meet the performance objective selected for Morton Elementary School Main Building. It is recommended that these deficiencies be addressed to provide nonstructural performance consistent with the performance of the upgraded structural lateral-force-resisting system. As-built information for the existing nonstructural systems, such as fire sprinklers, mechanical ductworks, and piping, are not available for review. Only limited visual observation of the systems was performed during field investigation due to limited access or visibility to observe existing conditions. The conceptual mitigation strategies provided in this study are preliminary only. The final analysis and design for seismic rehabilitation should include a detailed field investigation.

4.4.1 Architectural Systems

This section addresses existing construction that, while not posing specific hazards during a seismic event, would be affected by the seismic improvements proposed.

For any remodel project of an existing building, the International Existing Building Code (IEBC) would be applicable. The intent of the IEBC is to provide flexibility to permit the use of alternative approaches to achieve compliance with minimum requirements to safeguard the public health, safety, and welfare insofar as they are affected by the work being done.

Energy Code

Elements of the exterior building envelope being affected by the seismic work would also be required to be brought up to the current Washington State Energy Code per Chapter 5, where applicable.

Accessibility

It should also be noted that, as a part of any upgrade to existing buildings, the IEBC will require that any altered primary function spaces (classrooms, gyms, entrances, offices) and routes to these spaces, be made accessible to the current accessibility standards of the Americans with Disabilities Act (ADA), unless technically infeasible. This would include but is not limited to accessible restrooms, paths of travel, entrances and exits, parking, signage, and fire alarm systems. Under no circumstances should the facility be made less accessible. The IEBC does, however, have exceptions for areas that do not contain a primary function (storage room, utility rooms) and states that costs of providing the accessible route are not required to exceed 20 percent of the costs of the alterations affecting the area of Primary Function. As with any major renovation and modernization, an ADA study would be recommended to determine the extent to which an existing facility needs to be improved to be in compliance with the ADA.

Hazardous Materials Survey

It is recommended that all existing construction be surveyed for the presence of hazardous materials. Elements such as floor tile, adhesive, and pipe insulation could contain asbestos. Lead may be present in paint and light fixtures may contain PCB ballasts. A hazardous materials survey and abatement of the buildings should be performed prior to the start of any demolition work.

Roof Diaphragm Sheathing

Installation of a new plywood roof diaphragm and other seismic anchors will require removal of the existing roofing material to allow installation of new plywood sheathing. A new composite shingle roof system is recommended. As part of the re-roof project, the District might consider replacing the existing attic insulation with R-49 batt insulation to meet the current energy code. It is recommended that gutters and downspouts be replaced at the time of the roof replacement.

Strongbacking of Exterior Masonry

Where exposed to view, new vertical strongbacks installed along the building perimeter should be furred out with shallow metal studs and 5/8-inch gypsum wallboard. The gypsum wallboard should be painted and new resilient base installed on the furring.

New Shear Walls with Collectors and Foundations

Given the extent of work required to construct new 2 x 6 shear walls in the attic area, we recommend removing the entire first-floor ceiling and light fixtures and replacing with 5/8-inch gypsum wallboard and pendant-mounted linear, LED light fixtures. This will also facilitate installation of vertical strongbacks along the building perimeter up to the roof deck.

The ground floor ceiling and lighting will require removal and replacement to allow for installation of plywood sheathing and will also facilitate installation of the strongbacks and other anchorages. We recommend replacing the ceiling with 5/8-inch gypsum wallboard and pendant-mounted linear, LED light fixtures.

Where new plywood sheathing is called for on existing stud walls, the existing wall finishes will need to be removed and replaced with new 5/8-inch gypsum wallboard on each side. Existing electrical outlets, switches, and other items will need to be reinstalled in the new stud shear walls. Paint and new rubber base should be installed to match adjacent wall finishes. The District might consider installation of acoustical insulation in the stud cavity to mitigate sound transfer between rooms. Floor finishes should not require replacement provided they are protected.

Where new masonry shear walls are denoted on the ground floor, floor finishes will need to be removed in the rooms on either side of the new walls to allow for construction of footings. The masonry walls should be furred out with 3-5/8-inch metal studs and 5/8-inch gypsum wallboard on each side. Electrical devices and other existing items will need to be reinstalled in the furred cavity. Paint and new rubber base should be installed to match adjacent wall finishes. Floor finishes should be replaced with a seamless sheet vinyl in the kitchen and with vinyl composition tile elsewhere.

Where new concrete shear walls are denoted on the ground floor and first floor, they should be furred out with 6-inch metal studs and 5/8-inch gypsum wallboard on each side, with R-21 batt insulation to meet the current energy code. Electrical devices and other existing items will need to be reinstalled in the furred cavity. Paint and new rubber base should be installed to match adjacent wall finishes. Floor finishes may not need to be replaced, provided they are adequately protected. Where new concrete walls occur at window openings, the exterior face of the concrete infill should be sided with composite metal siding.

Contents and Furnishings

Buildings often contain various tall and narrow furniture, such as shelving and storage units, that are freestanding away from any backing walls. High book shelving in the library, for example, can be highly susceptible to toppling if not anchored properly to the backing walls or to each other, and can become a life safety hazard. It is recommended that maintenance and facility staff verify that the tops of the shelving units are braced or anchored to the nearest backing wall or provide overturning base restraint. Heavy items weighing more than 20 pounds on upper shelves or cabinet furniture should also be restrained by netting or cabling to avoid becoming falling hazards to students or faculty below.

4.4.2 Mechanical Systems

The main seismic concerns for mechanical equipment are sliding, swinging, and overturning. Inadequate lateral restraint or anchorage can shift equipment off its supports, topple equipment to the ground, or dislodge overhead equipment, making them falling hazards. Investigation of above-ceiling mechanical equipment and systems was not part of this study, but an initial investigation for the presence of mechanical equipment bracing can be performed by maintenance and facility staff to see if equipment weighing more than 20 pounds with a center of mass more than 4 feet above the adjacent floor level is laterally braced. If bracing is not present, and the equipment poses a falling hazard to students and faculty below, further investigation is recommended by a structural engineer.

4.5 Opinion of Probable Conceptual Seismic Upgrades Costs

An opinion of probable project costs of the concept-level seismic upgrade recommendations provided in this report is included in Appendix C. The input of the scope of work to develop the probable costs is the Tier 1 checklists and the preliminary concept-level seismic upgrades design recommendations and sketches. These preliminary concept-level design sketches depict a design concept that could be implemented to improve the seismic safety of the building structure. It is important to note the preliminary seismic upgrades design concept is based on the results of the Tier 1 seismic screening checklists and engineering design judgement and has not been substantiated by detailed structural analyses and calculations.

For this preliminary opinion of probable costs the estimate of construction costs of the preliminary scope of work is developed based on current 1st Quarter (1Q) 2021 costs. Costs are then escalated to 4Q 2022 at 6% per year of the baseline cost estimate. Costs are developed based on the Tier 1 checklist, concept-level seismic upgrade design sketches, and project narratives.

A range of the cost estimate of -20% (low) to +50% (high) is used to develop the range of the construction cost estimate for the concept-level scope of work. The -20% to +50% range guidance is from Table 1 of the AACE International Recommended Practice 56R-08, *Cost Estimate Classification System*. This estimate is classified as a Class 5 based on the level of design of 0% to 2%. The range of a Class 5 construction cost estimate based on the AACE guidance selected for this estimate is a -20% to +50%.

The estimated total cost (construction costs plus soft costs) to mitigate the deficiencies identified in the Tier 1 checklists of the Morton Elementary School Main Building ranges between approximately $4.45M and $8.35M (-20%/+50%). The baseline estimated total cost to seismically upgrade this building is approximately $5.57M. On a per-square-foot basis, the baseline seismic upgrade cost is estimated to be approximately $220 per square foot in 4Q 2022 dollars, with a range between $177 per square foot and $331per square foot. Note however that this estimated cost and cost range could be significantly higher if the presence of liquefiable soils is discovered and requires ground improvements on the Morton Elementary School campus to mitigate post-earthquake liquefaction settlement. A detailed geotechnical investigation is also recommended prior to doing a seismic upgrade design project.

4.5.1 Opinion of Probable Construction Costs

This conceptual opinion of construction cost includes labor, materials, equipment, and scope contingency, general contractor general conditions, home office overhead, and profit. This is based on a public sector design-bid-build project delivery method. Project delivery methods such as negotiated, state of Washington GC/CM, and design-build are not the basis of the construction costs. Owner's soft costs are described below in Section 4.5.2.

The cost is developed in 1Q 2021 costs. The costs are then escalated to 4Q 2022 using an escalation rate of 6.0% per year. If the mid-point of construction will occur at a date earlier or later than 4Q 2022, then it is appropriate to adjust the escalation to the revised mid-point of construction. Construction costs excluded from the estimate are site work, phasing of construction, additional building modifications not directly related to the seismic scope of work, off hours labor costs, accelerated schedule overtime labor costs, replacement/relocation/additional FF+E, and building code changes that occur after this report.

For project budget planning purposes, it is highly recommended that the opinion of probable project costs is determined including: the overall construction budget of the seismic upgrade and additional scope of work for the building via the services of an A/E design team to study the proposed seismic mitigation strategies to refine the concept-level seismic upgrades design approach contained in this report, determine the construction timeline to adjust the escalation costs, define the construction phasing, if any, and the project soft costs.

4.5.2 Opinion of Probable A-E Design Budgets and Owner's Additional Project Costs (Soft Costs)

Additional owner's project costs would likely include owner's project administration costs, including project management, financing/bond costs, administration/contract/accounting costs, review of plans, value engineering studies, building permits, bidding costs, equipment, fixtures, furnishings and technology, and relocation of the school staff and students during construction. These costs are known as soft costs.

These soft costs have been included in the opinion of probable costs at 40% of the baseline probable construction cost for the seismic upgrade of this building.
The soft costs used for the projects that total to 40% are:
A+E Design - 10%
QA/QC Testing - 2%
Project Administration - 2%
Owner Contingency - 11%
Average Washington State Sales Tax - 9%
Building Permits - 6%

It is typical for soft costs to vary from owner to owner. Based upon our team members' experience on K-12 school projects in the state of Washington, it is our opinion that an allowance of 40% of the average probable construction cost is a reasonable and appropriate soft cost recommendation for planning purposes. We also recommend that each owner develop their own soft costs as part of their budgeting process and not rely solely on this recommended percentage.

4.5.3 Opinion of Escalation Rate

A 6.0%/year construction cost escalation rate is used for planning purposes for the conceptual estimates. The rate is compounded annually to the projected midpoint of construction. This rate is representative of the escalation based on the previous five years of market experience of construction costs throughout the state of Washington and is projected going forward for these projects. This rate is calculated to the 4th Quarter of 2022 as an allowance for planning purposes. The actual construction schedule for the project is to be determined and we recommend the escalation cost be revised based on revised construction schedule using the 6%/year rate.

Table 4.5.3-1. Seismic Upgrades Opinion of Probable Construction Costs.

Building	FEMA Bldg Type	ASCE 41 Level of Seismicity / Site Class	Structural Performance Objective	Bldg Gross Area	Estimated Seismic Upgrade Cost Range $/SF (Total)	Estimated Seismic Upgrade Cost/SF (Total)
Morton Elementary School Main Bldg.	URM & C2a	High / C	**Structural**			
			Life Safety	25,200 SF	$70 ($1.77M) - $131 ($3.31M)	$88 ($2.21M)
			Nonstructural			
			Life Safety	25,200 SF	$56 ($1.41M) - $105 ($2.65M)	$70 ($1.77M)
			Total			
				25,200 SF	$126 ($3.18M) - $236 ($5.96M)	$158 ($3.98M)
					Estimated Soft Costs:	$1.59M
					Total Estimated Project Costs:	**$5.57M**

W: Wood-Framed; URM: Unreinforced Masonry; RM: Reinforced Masonry; C: Reinforced Concrete; PC: Precast concrete; S: Steel-framed

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Appendix A: ASCE 41 Tier 1 Screening Report

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1. Morton, Morton Elementary School, Main Building

1.1 Building Description

Building Name:	Main Building
Facility Name:	Morton Elementary School
District Name:	Morton
ICOS Latitude:	46.558
ICOS Longitude:	-122.279
ICOS County/District ID:	248
ICOS Building ID:	58501
ASCE 41 Bldg Type:	C2a/URM
Enrollment:	176
Gross Sq. Ft. :	25,182
Year Built:	1948
Number of Stories:	2
$S_{XS\ BSE\text{-}2E}$:	0.848
$S_{X1\ BSE\text{-}2E}$:	0.456
ASCE 41 Level of Seismicity:	High
Site Class:	C
V_{S30}(m/s):	455
Liquefaction Potential:	Moderate to High
Tsunami Risk:	None
Structural Drawings Available:	Partial
Evaluating Firm:	WRK Engineers

The Morton Elementary School main building is located on a flat site at the south-central area of the Morton Elementary School complex. The building is rectangular in plan and has a footprint of 206 feet by 60 feet. The main building, constructed in 1948, consists of a two-story masonry and concrete building. A remodel in 1987 removed play areas and added classrooms, administrative rooms, and a library. The building currently contains a cafeteria, stage, library, mechanical room, classrooms, and various administrative spaces. The roof system consists of straight sheathing over wood purlins. The purlins span between wood beams supported by columns and brick masonry walls. The first floor diaphragm consists of straight sheathing over wood joists. The joists span between the steel beams, concrete walls, and stud walls. The steel beams are supported by steel columns and concrete walls. The ground floor consists of a concrete slab. The foundation consists of conventional concrete wall footings and spread footings. The lateral system consists of flexible diaphragms, unreinforced masonry shear walls, and concrete shear walls. The roof diaphragm spans between exterior URM walls. The first floor wood diaphragm spans between concrete walls with wall footings.

1.1.1 Building Use

The Morton Elementary School includes classrooms, a lunchroom, a kitchen, a library, and administrative offices.

1.1.2 Structural System

Table 1.1-1. Structural System Description of Morton Elementary School

Structural System	Description
Structural Roof	The roof system is composed of built-up wood trusses and purlins.
Structural Floor(s)	The floor system is composed of wood joists and straight sheathing.
Foundations	The walls and columns are supported by spread footings.
Gravity System	The gravity system consists of steel beams and columns, wood joists, concrete walls, brick masonry walls, and wood stud walls.
Lateral System	Concrete shear and unreinforced masonry shear walls resist the forces in the longitudinal and transverse directions with flexible wood diaphragms at the second floor and roof.

1.1.3 Structural System Visual Condition

Table 1.1-2. Structural System Condition Description of Morton Elementary School

Structural System	Description
Structural Roof	No visible signs of corrosion, damage, or deterioration.
Structural Floor(s)	No visible signs of corrosion, damage, or deterioration.
Foundations	Unknown, not visible.
Gravity System	Cracking observed on interior wall at stairwell. Cracking of brick veneer along west exterior wall.
Lateral System	No visible signs of corrosion, damage, or deterioration.

Photos:

Figure 1-1. Morton Elementary School - South Exterior

Figure 1-2. Morton Elementary School - West Exterior

Figure 1-3. Library Bookshelves Should Be Braced

Figure 1-4. Kitchen - Tall Nonstructural Components Unbraced

Figure 1-5. Mechanical Room with Unbraced Equipment

Figure 1-6. Cracking at Interior Finishes

Figure 1-7. Morton Elementary School - East Exterior

Figure 1-8. Morton Elementary School - North Exterior

Figure 1-9. Typical Classroom with Unbraced Nonstructural Components

Figure 1-10. Unknown Ceiling Finish Bracing, Typical

1.2 Seismic Evaluation Findings

1.2.1 Structural Seismic Deficiencies

The structural seismic deficiencies identified during the Tier 1 evaluation are summarized below. Commentary for each deficiency is also provided based on this evaluation.

Table 1-3. Identified Structural Seismic Deficiencies for Morton Morton Elementary School Main Building

Deficiency	Description
Wall Anchorage at Flexible Diaphragms	This evaluation item is likely non-compliant due to the building's age and could not be visually verified. This item requires further investigation to make a final determination. The addition of tension ties, blocking, strapping, and diaphragm nailing may be appropriate to mitigate seismic risk.
Foundation Dowels	No wall reinforcement is doweled into the foundation. A direct, structural connection, such as FRP, between the walls and the foundation should be provided to mitigate seismic risk.
Cross Ties	There are no continuous cross ties between diaphragm chords. The addition of new cross ties between diaphragm chords or the addition of strap plates to connect existing framing members together may be appropriate to mitigate seismic risk.
Straight Sheathing	Straight-sheathed diaphragms have aspect ratios greater than 2-to-1. Diaphragm strengthening, such as the addition of plywood sheathing, may be appropriate.
Spans	Diaphragms are straight-sheathed. Installation of plywood sheathing may be appropriate.
Proportions	A quick calculation indicates the top story does not comply. Further investigation should be performed prior to retrofit. URM out-of-plane strengthening, such as a steel strongback system, is likely required.
Shear Stress Check	Per the Quick Check procedure, the shear stress of both the concrete and URM shear walls are noncompliant. Further investigation should be performed prior to retrofit. Lateral system strengthening, such as shotcreting walls or adding new shear walls or braced frames may be appropriate to mitigate seismic risk.
Stiffness of Wall Anchors	The masonry walls do not have viable wall anchors. The joist bridging that anchors to the wall is only clipped to the joists and is not sufficiently attached to be a rigid out-of-plane wall anchor connection. Replacement of anchors or the addition of new post-installed anchors may be appropriate to mitigate seismic risk.

1.2.2 Structural Checklist Items Marked as 'U'nknown

Where building structural component seismic adequacy was unknown due to lack of available information or limited observation, the structural checklist items were marked as “unknown”. These items require further investigation if definitive determination of compliance or noncompliance is desired. The unknown structural checklist items identified during the Tier 1 evaluation are summarized below. Commentary for each unknown item is also provided based on the evaluation.

Table 1-4. Identified Structural Checklist Items Marked as Unknown for Morton Morton Elementary School Main Building

Unknown Item	Description
Load Path	Drawings provided are incomplete and a complete, viable load path could not be visually verified. This evaluation item is likely non-compliant due to the building's age. This item requires further investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.
Liquefaction	The liquefaction potential of site soils is unknown at this time given available information. Moderate to high liquefaction potential is identified per ICOS based on state geologic mapping. Requires further investigation by a licensed geotechnical engineer to determine liquefaction potential.
Slope Failure	Requires further investigation by a licensed geotechnical engineer to determine susceptibility to slope failure.
Surface Fault Rupture	Requires further investigation by a licensed geotechnical engineer to determine whether site is near locations of expected surface fault ruptures.
Complete Frames	This evaluation item is unknown and likely non-compliant due to the building's age and could not be visually verified. This item requires further investigation to make a final determination and to develop a mitigation recommendation, if necessary.
Reinforcing Steel	This evaluation item is unknown due to the incomplete construction drawings. This item requires further investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.
Transfer to Shear Walls	This evaluation item is unknown due to the incomplete construction drawings. This item requires further investigation to make a final determination on its compliance. Direct, structural connections, such as post-installed anchors, between the diaphragm and the concrete shear walls may be required.
Deflection Compatibility	This evaluation item is unknown and likely non-compliant due to the building's age and could not be visually verified. This item requires further investigation to make a final determination and to develop a mitigation recommendation, if necessary.

1.3.1 Nonstructural Seismic Deficiencies

The nonstructural seismic deficiencies identified during the Tier 1 evaluation are summarized below. Commentary for each deficiency is also provided based on this evaluation. Some nonstructural deficiencies may be able to be mitigated by school district staff. Other nonstructural components that require more substantial mitigation may be more appropriately included in a long-term mitigation strategy. Some typical conceptual details for the seismic upgrade of nonstructural components can be found in the FEMA E-74 Excerpts appendix.

Table 1-5. Identified Nonstructural Seismic Deficiencies for Morton Morton Elementary School Main Building

Deficiency	Description
HM-3 Hazardous Material Distribution. HR-MH; LS-MH; PR-MH.	Piping/ductwork did not appear to be adequately braced. Bracing for all hazardous material piping/ductwork may be appropriate to mitigate seismic risk.
HM-5 Flexible Couplings. HR-LMH; LS-LMH; PR-LMH.	It appears that the piping has fixed connections. Installation of flexible couplings may be appropriate to mitigate seismic risk.
S-1 Stair Enclosures. HR-not required; LS-LMH; PR-LMH.	It appears that the 12-to-1 height-to-thickness ratio is exceeded on the 2nd floor. Bracing for the wall may be appropriate to mitigate seismic risk.
CF-2 Tall Narrow Contents. HR-not required; LS-H; PR-MH.	Anchorage is required for tall narrow contents more than six feet high to provide overturning restraint.
CF-3 Fall-Prone Contents. HR-not required; LS-H; PR-H.	Bookshelves appear to support heavy items that do not appear well secured. Heavy items on upper shelves should be restrained by netting or cabling to mitigate seismic risk.

1.3.2 Nonstructural Checklist Items Marked as 'U'nknown

Where building nonstructural component seismic adequacy was unknown due to lack of available information or limited observation, the nonstructural checklist items were marked as “unknown”. These items require further investigation if definitive determination of compliance or noncompliance is desired. The unknown nonstructural checklist items identified during the Tier 1 evaluation are summarized below. Commentary for each unknown item is also provided based on the evaluation.

Some nonstructural deficiencies may be able to be mitigated by school district staff. Other nonstructural components that require more substantial mitigation may be more appropriately included in a long-term mitigation strategy. Some typical conceptual details for the seismic upgrade of nonstructural components can be found in the FEMA E-74 Excerpts appendix.

Table 1-6. Identified Nonstructural Checklist Items Marked as Unknown for Morton Morton Elementary School Main Building

Unknown Item	Description
LSS-4 Stair and Smoke Ducts. HR-not required; LS-LMH; PR-LMH.	Further investigation is required to review stair and smoke ducts for bracing and flexible connections at seismic joints.
HM-4 Shutoff Valves. HR-MH; LS-MH; PR-MH.	Presence and location of shutoff valves to hazardous materials, including natural gas, should be done by school maintenance/facility staff.
C-1 Suspended Lath and Plaster. HR-H; LS-MH; PR-LMH.	Further investigation is required to review suspended ceiling attachments.
C-2 Suspended Gypsum Board. HR-not required; LS-MH; PR-LMH.	Further investigation is required to review suspended ceiling attachments.
LF-1 Independent Support. HR-not required; LS-MH; PR-MH.	Further investigation is required to review the support system for light fixtures. All light fixtures in grid ceiling system should have seismic bracing.
CG-8 Overhead Glazing. HR-not required; LS-MH; PR-MH.	Further investigation is required to verify detailing of glazing panes.
M-1 Ties. HR-not required; LS-LMH; PR-LMH.	Further investigation is required to verify detailing of masonry veneer ties. Installation of masonry ties may be appropriate if non-existent.
M-2 Shelf Angles. HR-not required; LS-LMH; PR-LMH.	Further investigation is required to verify the method of support of masonry veneer at each floor above grade.
M-3 Weakened Planes. HR-not required; LS-LMH; PR-LMH.	Further investigation is required to verify anchorage of masonry veneer at weakened planes.
PCOA-2 Canopies. HR-not required; LS-LMH; PR-LMH.	Further investigation is required to verify anchorage of canopies at building exits to the main structure.
S-2 Stair Details. HR-not required; LS-LMH; PR-LMH.	Further investigation is required to verify stair connections.

Morton, Morton Elementary School, Main Building

17-2 Collapse Prevention Basic Configuration Checklist

Building record drawings have been reviewed, when available, and a non-destructive field investigation has been performed for the subject building. Each of the required checklist items are marked Compliant (C), Noncompliant (NC), Not Applicable (N/A), or Unknown (U). Items marked Compliant indicate conditions that satisfy the performance objective, whereas items marked Noncompliant or Unknown indicate conditions that do not. Certain statements might not apply to the building being evaluated.

Low Seismicity

Building System - General

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Load Path	The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation. (Tier 2: Sec. 5.4.1.1; Commentary: Sec. A.2.1.10)				X	Drawings provided are incomplete and a complete, viable load path could not be visually verified. This evaluation item is likely non-compliant due to the building's age. This item requires further investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.
Adjacent Buildings	The clear distance between the building being evaluated and any adjacent building is greater than 0.25% of the height of the shorter building in low seismicity, 0.5% in moderate seismicity, and 1.5% in high seismicity. (Tier 2: Sec. 5.4.1.2; Commentary: Sec. A.2.1.2)	X				
Mezzanines	Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. (Tier 2: Sec. 5.4.1.3; Commentary: Sec. A.2.1.3)			X		

Building System - Building Configuration

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Weak Story	The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above. (Tier 2: Sec. 5.4.2.1; Commentary: Sec. A.2.2.2)	X				

Soft Story	The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above. (Tier 2: Sec. 5.4.2.2; Commentary: Sec. A.2.2.3)	X				
Vertical Irregularities	All vertical elements in the seismic-force-resisting system are continuous to the foundation. (Tier 2: Sec. 5.4.2.3; Commentary: Sec. A.2.2.4)	X				
Geometry	There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 5.4.2.4; Commentary: Sec. A.2.2.5)	X				
Mass	There is no change in effective mass of more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 5.4.2.5; Commentary: Sec. A.2.2.6)	X				
Torsion	The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension. (Tier 2: Sec. 5.4.2.6; Commentary: Sec. A.2.2.7)	X				

Moderate Seismicity (Complete the Following Items in Addition to the Items for Low Seismicity)

Geologic Site Hazards

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Liquefaction	Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2 m) under the building. (Tier 2: Sec. 5.4.3.1; Commentary: Sec. A.6.1.1)				X	The liquefaction potential of site soils is unknown at this time given available information. Moderate to high liquefaction potential is identified per ICOS based on state geologic mapping. Requires further investigation by a licensed geotechnical engineer to determine liquefaction potential.
Slope Failure	The building site is located away from potential earthquake-induced slope failures or rockfalls so that it is unaffected by such failures or is capable of accommodating any predicted movements without failure. (Tier 2: Sec. 5.4.3.1; Commentary: Sec. A.6.1.2)				X	Requires further investigation by a licensed geotechnical engineer to determine susceptibility to slope failure.

Surface Fault Rupture	Surface fault rupture and surface displacement at the building site are not anticipated. (Tier 2: Sec. 5.4.3.1; Commentary: Sec. A.6.1.3)				X	Requires further investigation by a licensed geotechnical engineer to determine whether site is near locations of expected surface fault ruptures.

High Seismicity (Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)

Foundation Configuration

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Overturning	The ratio of the least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than 0.6Sa. (Tier 2: Sec. 5.4.3.3; Commentary: Sec. A.6.2.1)	X				
Ties Between Foundation Elements	The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C. (Tier 2: Sec. 5.4.3.4; Commentary: Sec. A.6.2.2)			X		

17-24 Collapse Prevention Structural Checklist for Building Types C2 and C2a

Building record drawings have been reviewed, when available, and a non-destructive field investigation has been performed for the subject building. Each of the required checklist items are marked Compliant (C), Noncompliant (NC), Not Applicable (N/A), or Unknown (U). Items marked Compliant indicate conditions that satisfy the performance objective, whereas items marked Noncompliant or Unknown indicate conditions that do not. Certain statements might not apply to the building being evaluated.

Low and Moderate Seismicity

Seismic-Force-Resisting System

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Complete Frames	Steel or concrete frames classified as secondary components form a complete vertical-load-carrying system. (Tier 2: Sec. 5.5.2.5.1; Commentary: Sec. A.3.1.6.1)				X	This evaluation item is unknown and likely non-compliant due to the building's age and could not be visually verified. This item requires further investigation to make a final determination and to develop a mitigation recommendation, if necessary.
Redundancy	The number of lines of shear walls in each principal direction is greater than or equal to 2. (Tier 2: Sec.5.5.1.1; Commentary: Sec. A.3.2.1.1)	X				
Shear Stress Check	The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the greater of 100 lb/in.2 (0.69 MPa) or $2\sqrt{f'c}$. (Tier 2: Sec.5.5.3.1.1; Commentary: Sec. A.3.2.2.1)	X				
Reinforcing Steel	The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction. (Tier 2: Sec.5.5.3.1.3; Commentary: Sec. A.3.2.2.2)				X	This evaluation item is unknown due to the incomplete construction drawings. This item requires further investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.

Connections

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT

Wall Anchorage at Flexible Diaphragms	Exterior concrete or masonry walls that are dependent on flexible diaphragms for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7. (Tier 2: Sec.5.7.1.1; Commentary: Sec. A.5.1.1)		X			This evaluation item is likely non-compliant due to the building's age and could not be visually verified. This item requires further investigation to make a final determination. The addition of tension ties, blocking, strapping, and diaphragm nailing may be appropriate to mitigate seismic risk.
Transfer to Shear Walls	Diaphragms are connected for transfer of seismic forces to the shear walls. (Tier 2: Sec.5.7.2; Commentary: Sec. A.5.2.1)				X	This evaluation item is unknown due to the incomplete construction drawings. This item requires further investigation to make a final determination on its compliance. Direct, structural connections, such as post-installed anchors, between the diaphragm and the concrete shear walls may be required.
Foundation Dowels	Wall reinforcement is doweled into the foundation with vertical bars equal in size and spacing to the vertical wall reinforcing directly above the foundation. (Tier 2: Sec.5.7.3.4; Commentary: Sec. A.5.3.5)		X			No wall reinforcement is doweled into the foundation. A direct, structural connection, such as FRP, between the walls and the foundation should be provided to mitigate seismic risk.

High Seismicity **(Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)**

Seismic-Force-Resisting System

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Deflection Compatibility	Secondary components have the shear capacity to develop the flexural strength of the components. (Tier 2: Sec.5.5.2.5.2; Commentary: Sec. A.3.1.6.2)				X	This evaluation item is unknown and likely non-compliant due to the building's age and could not be visually verified. This item requires further investigation to make a final determination and to develop a mitigation recommendation, if necessary.
Flat Slabs	Flat slabs or plates not part of the seismic-force-resisting system have continuous bottom steel through the column joints. (Tier 2: Sec.5.5.2.5.3; Commentary: Sec. A.3.1.6.3)			X		

Coupling Beams	The ends of both walls to which the coupling beam is attached are supported at each end to resist vertical loads caused by overturning. (Tier 2: Sec.5.5.3.2.1; Commentary: Sec. A.3.2.2.3)			X		

Diaphragms (Stiff or Flexible)

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Diaphragm Continuity	The diaphragms are not composed of split-level floors and do not have expansion joints. (Tier 2: Sec.5.6.1.1; Commentary: Sec. A.4.1.1)	X				
Openings at Shear Walls	Diaphragm openings immediately adjacent to the shear walls are less than 25% of the wall length. (Tier 2: Sec.5.6.1.3; Commentary: Sec. A.4.1.4)			X		

Flexible Diaphragms

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Cross Ties	There are continuous cross ties between diaphragm chords. (Tier 2: Sec.5.6.1.2; Commentary: Sec. A.4.1.2)		X			There are no continuous cross ties between diaphragm chords. The addition of new cross ties between diaphragm chords or the addition of strap plates to connect existing framing members together may be appropriate to mitigate seismic risk.
Straight Sheathing	All straight-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered. (Tier 2: Sec.5.6.2; Commentary: Sec. A.4.2.1)		X			Straight-sheathed diaphragms have aspect ratios greater than 2-to-1. Diaphragm strengthening, such as the addition of plywood sheathing, may be appropriate.
Spans	All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing. (Tier 2: Sec.5.6.2; Commentary: Sec. A.4.2.2)		X			Diaphragms are straight-sheathed. Installation of plywood sheathing may be appropriate.
Diagonally Sheathed and Unblocked Diaphragms	All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12.2 m) and aspect ratios less than or equal to 4 to-1. (Tier 2: Sec.5.6.2; Commentary: Sec. A.4.2.3)			X		
Other Diaphragms	Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Tier 2: Sec.5.6.5; Commentary: Sec. A.4.7.1)	X				

Connections

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT

Uplift at Pile Caps	Pile caps have top reinforcement, and piles are anchored to the pile caps. (Tier 2: Sec.5.7.3.5; Commentary: Sec. A.5.3.8)			X		

Morton, Morton Elementary School, Main Building

17-38 Nonstructural Checklist

Notes:
C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.
Performance Level: HR = Hazards Reduced, LS = Life Safety, and PR = Position Retention.
Level of Seismicity: L = Low, M = Moderate, and H = High

Life Safety Systems

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
LSS-1 Fire Suppression Piping. HR-not required; LS-LMH; PR-LMH.	Fire suppression piping is anchored and braced in accordance with NFPA-13. (Tier 2: Sec. 13.7.4; Commentary: Sec. A.7.13.1)			X		No fire sprinklers
LSS-2 Flexible Couplings. HR-not required; LS-LMH; PR-LMH.	Fire suppression piping has flexible couplings in accordance with NFPA-13. (Tier 2: Sec. 13.7.4; Commentary: Sec. A.7.13.2)			X		
LSS-3 Emergency Power. HR-not required; LS-LMH; PR-LMH.	Equipment used to power or control Life Safety systems is anchored or braced. (Tier 2: Sec. 13.7.7; Commentary: Sec. A.7.12.1)			X		No emergency generator
LSS-4 Stair and Smoke Ducts. HR-not required; LS-LMH; PR-LMH.	Stair pressurization and smoke control ducts are braced and have flexible connections at seismic joints. (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.1)				X	Further investigation is required to review stair and smoke ducts for bracing and flexible connections at seismic joints.
LSS-5 Sprinkler Ceiling Clearance. HR-not required; LS-MH; PR-MH.	Penetrations through panelized ceilings for fire suppression devices provide clearances in accordance with NFPA-13. (Tier 2: Sec. 13.7.4; Commentary: Sec. A.7.13.3)			X		
LSS-6 Emergency Lighting. HR-not required; LS-not required; PR-LMH	Emergency and egress lighting equipment is anchored or braced. (Tier 2: Sec. 13.7.9; Commentary: Sec. A.7.3.1)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

Hazardous Materials

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
HM-1 Hazardous Material Equipment. HR-LMH; LS-LMH; PR-LMH.	Equipment mounted on vibration isolators and containing hazardous material is equipped with restraints or snubbers. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.2)			X		
HM-2 Hazardous Material Storage. HR-LMH; LS-LMH; PR-LMH.	Breakable containers that hold hazardous material, including gas cylinders, are restrained by latched doors, shelf lips, wires, or other methods. (Tier 2: Sec. 13.8.3; Commentary: Sec. A.7.15.1)			X		

HM-3 Hazardous Material Distribution. HR-MH; LS-MH; PR-MH.	Piping or ductwork conveying hazardous materials is braced or otherwise protected from damage that would allow hazardous material release. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.4)		X			Piping/ductwork did not appear to be adequately braced. Bracing for all hazardous material piping/ductwork may be appropriate to mitigate seismic risk.
HM-4 Shutoff Valves. HR-MH; LS-MH; PR-MH.	Piping containing hazardous material, including natural gas, has shutoff valves or other devices to limit spills or leaks. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.3)				X	Presence and location of shutoff valves to hazardous materials, including natural gas, should be done by school maintenance/facility staff.
HM-5 Flexible Couplings. HR-LMH; LS-LMH; PR-LMH.	Hazardous material ductwork and piping, including natural gas piping, have flexible couplings. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.15.4)		X			It appears that the piping has fixed connections. Installation of flexible couplings may be appropriate to mitigate seismic risk.
HM-6 Piping or Ducts Crossing Seismic Joints. HR-MH; LS-MH; PR-MH.	Piping or ductwork carrying hazardous material that either crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Tier 2: Sec. 13.7.3, 13.7.5, 13.7.6; Commentary: Sec. A.7.13.6)			X		

Partitions

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
P-1 Unreinforced Masonry. HR-LMH; LS-LMH; PR-LMH.	Unreinforced masonry or hollow-clay tile partitions are braced at a spacing of at most 10 ft (3.0 m) in Low or Moderate Seismicity, or at most 6 ft (1.8 m) in High Seismicity. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.1)			X		
P-2 Heavy Partitions Supported by Ceilings. HR-LMH; LS-LMH; PR-LMH.	The tops of masonry or hollow-clay tile partitions are not laterally supported by an integrated ceiling system. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.2.1)			X		
P-3 Drift. HR-not required; LS-MH; PR-MH.	Rigid cementitious partitions are detailed to accommodate the following drift ratios: in steel moment frame, concrete moment frame, and wood frame buildings, 0.02; in other buildings, 0.005. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.2)			X		
P-4 Light Partitions Supported by Ceilings. HR-not required; LS-not required; PR-MH.	The tops of gypsum board partitions are not laterally supported by an integrated ceiling system. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.2.1)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

P-5 Structural Separations. HR-not required; LS-not required; PR-MH.	Partitions that cross structural separations have seismic or control joints. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.3)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
P-6 Tops. HR-not required; LS-not required; PR-MH.	The tops of ceiling-high framed or panelized partitions have lateral bracing to the structure at a spacing equal to or less than 6 ft (1.8 m). (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.4)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

Ceilings

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
C-1 Suspended Lath and Plaster. HR-H; LS-MH; PR-LMH.	Suspended lath and plaster ceilings have attachments that resist seismic forces for every 12 ft2 (1.1 m2) of area. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.3)				X	Further investigation is required to review suspended ceiling attachments.
C-2 Suspended Gypsum Board. HR-not required; LS-MH; PR-LMH.	Suspended gypsum board ceilings have attachments that resist seismic forces for every 12 ft2 (1.1 m2) of area. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.3)				X	Further investigation is required to review suspended ceiling attachments.
C-3 Integrated Ceilings. HR-not required; LS-not required; PR-MH.	Integrated suspended ceilings with continuous areas greater than 144 ft2 (13.4 m2) and ceilings of smaller areas that are not surrounded by restraining partitions are laterally restrained at a spacing no greater than 12 ft (3.6 m) with members attached to the structure above. Each restraint location has a minimum of four diagonal wires and compression struts, or diagonal members capable of resisting compression. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.2)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
C-4 Edge Clearance. HR-not required; LS-not required; PR-MH.	The free edges of integrated suspended ceilings with continuous areas greater than 144 ft2 (13.4 m2) have clearances from the enclosing wall or partition of at least the following: in Moderate Seismicity, 1/2 in. (13 mm); in High Seismicity, 3/4 in. (19 mm). (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.4)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
C-5 Continuity Across Structure Joints. HR-not required; LS-not required; PR-MH.	The ceiling system does not cross any seismic joint and is not attached to multiple independent structures. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.5)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
C-6 Edge Support. HR-not required; LS-not required; PR-H.	The free edges of integrated suspended ceilings with continuous areas greater than 144 ft2 (13.4 m2) are supported by closure angles or channels not less than 2 in. (51 mm) wide. (Tier 2: Sec. 13.6.4 ; Commentary: Sec. A.7.2.6)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

C-7 Seismic Joints. HR-not required; LS-not required; PR-H.	Acoustical tile or lay-in panel ceilings have seismic separation joints such that each continuous portion of the ceiling is no more than 2,500 ft2 (232.3 m2) and has a ratio of long-to-short dimension no more than 4-to-1. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.7)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

Light Fixtures

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
LF-1 Independent Support. HR-not required; LS-MH; PR-MH.	Light fixtures that weigh more per square foot than the ceiling they penetrate are supported independent of the grid ceiling suspension system by a minimum of two wires at diagonally opposite corners of each fixture. (Tier 2: Sec. 13.6.4, 13.7.9; Commentary: Sec. A.7.3.2)				X	Further investigation is required to review the support system for light fixtures. All light fixtures in grid ceiling system should have seismic bracing.
LF-2 Pendant Supports. HR-not required; LS-not required; PR-H.	Light fixtures on pendant supports are attached at a spacing equal to or less than 6 ft. Unbraced suspended fixtures are free to allow a 360-degree range of motion at an angle not less than 45 degrees from horizontal without contacting adjacent components. Alternatively, if rigidly supported and/or braced, they are free to move with the structure to which they are attached without damaging adjoining components. Additionally, the connection to the structure is capable of accommodating the movement without failure. (Tier 2: Sec. 13.7.9; Commentary: Sec. A.7.3.3)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
LF-3 Lens Covers. HR-not required; LS-not required; PR-H.	Lens covers on light fixtures are attached with safety devices. (Tier 2: Sec. 13.7.9; Commentary: Sec. A.7.3.4)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

Cladding and Glazing

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
CG-1 Cladding Anchors. HR-MH; LS-MH; PR-MH.	Cladding components weighing more than 10 lb/ft2 (0.48 kN/m2) are mechanically anchored to the structure at a spacing equal to or less than the following: for Life Safety in Moderate Seismicity, 6 ft (1.8 m); for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 ft (1.2 m) (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.1)			X		

CG-2 Cladding Isolation. HR-not required; LS-MH; PR-MH.	For steel or concrete moment-frame buildings, panel connections are detailed to accommodate a story drift ratio by the use of rods attached to framing with oversize holes or slotted holes of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02, and the rods have a length-to-diameter ratio of 4.0 or less. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.3)			X		
CG-3 Multi-Story Panels. HR-MH; LS-MH; PR-MH.	For multi-story panels attached at more than one floor level, panel connections are detailed to accommodate a story drift ratio by the use of rods attached to framing with oversize holes or slotted holes of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02, and the rods have a length-to-diameter ratio of 4.0 or less. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.4)			X		
CG-4 Threaded Rods. HR-not required; LS-MH; PR-MH.	Threaded rods for panel connections detailed to accommodate drift by bending of the rod have a length-to-diameter ratio greater than 0.06 times the story height in inches for Life Safety in Moderate Seismicity and 0.12 times the story height in inches for Life Safety in High Seismicity and Position Retention in any seismicity. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.9)			X		
CG-5 Panel Connections. HR-MH; LS-MH; PR-MH.	Cladding panels are anchored out of plane with a minimum number of connections for each wall panel, as follows: for Life Safety in Moderate Seismicity, 2 connections; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 connections. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.5)			X		
CG-6 Bearing Connections. HR-MH; LS-MH; PR-MH.	Where bearing connections are used, there is a minimum of two bearing connections for each cladding panel. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.6)			X		
CG-7 Inserts. HR-MH; LS-MH; PR-MH.	Where concrete cladding components use inserts, the inserts have positive anchorage or are anchored to reinforcing steel. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.7)			X		

CG-8 Overhead Glazing. HR-not required; LS-MH; PR-MH.	Glazing panes of any size in curtain walls and individual interior or exterior panes more than 16 ft2 (1.5 m2) in area are laminated annealed or laminated heat-strengthened glass and are detailed to remain in the frame when cracked. (Tier 2: Sec. 13.6.1.5; Commentary: Sec. A.7.4.8)				X	Further investigation is required to verify detailing of glazing panes.

Masonry Veneer

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
M-1 Ties. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is connected to the backup with corrosion-resistant ties. There is a minimum of one tie for every 2-2/3 ft2 (0.25 m2), and the ties have spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 36 in. (914 mm); for Life Safety in High Seismicity and for Position Retention in any seismicity, 24 in. (610 mm). (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.1)				X	Further investigation is required to verify detailing of masonry veneer ties. Installation of masonry ties may be appropriate if non-existent.
M-2 Shelf Angles. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is supported by shelf angles or other elements at each floor above the ground floor. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.2)				X	Further investigation is required to verify the method of support of masonry veneer at each floor above grade.
M-3 Weakened Planes. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is anchored to the backup adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.3)				X	Further investigation is required to verify anchorage of masonry veneer at weakened planes.
M-4 Unreinforced Masonry Backup. HR-LMH; LS-LMH; PR-LMH.	There is no unreinforced masonry backup. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.7.2)	X				
M-5 Stud Tracks. HR-not required; LS-MH; PR-MH.	For veneer with coldformed steel stud backup, stud tracks are fastened to the structure at a spacing equal to or less than 24 in. (610 mm) on center. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.6.)			X		
M-6 Anchorage. HR-not required; LS-MH; PR-MH.	For veneer with concrete block or masonry backup, the backup is positively anchored to the structure at a horizontal spacing equal to or less than 4 ft along the floors and roof. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.7.1)			X		
M-7 Weep Holes. HR-not required; LS-not required; PR-MH.	In veneer anchored to stud walls, the veneer has functioning weep holes and base flashing. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.6)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
M-8 Openings. HR-not required; LS-not required; PR-MH.	For veneer with cold-formed-steel stud backup, steel studs frame window and door openings. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.6.2)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

Parapets, Cornices, Ornamentation, and Appendages

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
PCOA-1 URM Parapets or Cornices. HR-LMH; LS-LMH; PR-LMH.	Laterally unsupported unreinforced masonry parapets or cornices have height-tothickness ratios no greater than the following: for Life Safety in Low or Moderate Seismicity, 2.5; for Life Safety in High Seismicity and for Position Retention in any seismicity, 1.5. (Tier 2: Sec. 13.6.5; Commentary: Sec. A.7.8.1)			X		
PCOA-2 Canopies. HR-not required; LS-LMH; PR-LMH.	Canopies at building exits are anchored to the structure at a spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 10 ft (3.0 m); for Life Safety in High Seismicity and for Position Retention in any seismicity, 6 ft (1.8 m). (Tier 2: Sec. 13.6.6; Commentary: Sec. A.7.8.2)				X	Further investigation is required to verify anchorage of canopies at building exits to the main structure.
PCOA-3 Concrete Parapets. HR-H; LS-MH; PR-LMH.	Concrete parapets with height-to-thickness ratios greater than 2.5 have vertical reinforcement. (Tier 2: Sec. 13.6.5; Commentary: Sec. A.7.8.3)			X		
PCOA-4 Appendages. HR-MH; LS-MH; PR-LMH.	Cornices, parapets, signs, and other ornamentation or appendages that extend above the highest point of anchorage to the structure or cantilever from components are reinforced and anchored to the structural system at a spacing equal to or less than 6 ft (1.8 m). This evaluation statement item does not apply to parapets or cornices covered by other evaluation statements. (Tier 2: Sec. 13.6.6; Commentary: Sec. A.7.8.4)			X		

Masonry Chimneys

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
MC-1 URM Chimneys. HR-LMH; LS-LMH; PR-LMH.	Unreinforced masonry chimneys extend above the roof surface no more than the following: for Life Safety in Low or Moderate Seismicity, 3 times the least dimension of the chimney; for Life Safety in High Seismicity and for Position Retention in any seismicity, 2 times the least dimension of the chimney. (Tier 2: Sec. 13.6.7; Commentary: Sec. A.7.9.1)			X		
MC-2 Anchorage. HR-LMH; LS-LMH; PR-LMH.	Masonry chimneys are anchored at each floor level, at the topmost ceiling level, and at the roof. (Tier 2: Sec. 13.6.7; Commentary: Sec. A.7.9.2)			X		

Stairs

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
S-1 Stair Enclosures. HR-not required; LS-LMH; PR-LMH.	Hollow-clay tile or unreinforced masonry walls around stair enclosures are restrained out of plane and have height-to-thickness ratios not greater than the following: for Life Safety in Low or Moderate Seismicity, 15-to-1; for Life Safety in High Seismicity and for Position Retention in any seismicity, 12-to-1. (Tier 2: Sec. 13.6.2, 13.6.8; Commentary: Sec. A.7.10.1)		X			It appears that the 12-to-1 height-to-thickness ratio is exceeded on the 2nd floor. Bracing for the wall may be appropriate to mitigate seismic risk.
S-2 Stair Details. HR-not required; LS-LMH; PR-LMH.	The connection between the stairs and the structure does not rely on post-installed anchors in concrete or masonry, and the stair details are capable of accommodating the drift calculated using the Quick Check procedure of Section 4.4.3.1 for moment-frame structures or 0.5 in. for all other structures without including any lateral stiffness contribution from the stairs. (Tier 2: Sec. 13.6.8; Commentary: Sec. A.7.10.2)				X	Further investigation is required to verify stair connections.

Contents and Furnishings

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
CF-1 Industrial Storage Racks. HR-LMH; LS-MH; PR-MH.	Industrial storage racks or pallet racks more than 12 ft high meet the requirements of ANSI/RMI MH 16.1 as modified by ASCE 7, Chapter 15. (Tier 2: Sec. 13.8.1; Commentary: Sec. A.7.11.1)			X		
CF-2 Tall Narrow Contents. HR-not required; LS-H; PR-MH.	Contents more than 6 ft (1.8 m) high with a height-to-depth or height-to-width ratio greater than 3-to-1 are anchored to the structure or to each other. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.2)		X			Anchorage is required for tall narrow contents more than six feet high to provide overturning restraint.
CF-3 Fall-Prone Contents. HR-not required; LS-H; PR-H.	Equipment, stored items, or other contents weighing more than 20 lb (9.1 kg) whose center of mass is more than 4 ft (1.2 m) above the adjacent floor level are braced or otherwise restrained. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.3)		X			Bookshelves appear to support heavy items that do not appear well secured. Heavy items on upper shelves should be restrained by netting or cabling to mitigate seismic risk.
CF-4 Access Floors. HR-not required; LS-not required; PR-MH.	Access floors more than 9 in. (229 mm) high are braced. (Tier 2: Sec. 13.6.10; Commentary: Sec. A.7.11.4)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
CF-5 Equipment on Access Floors. HR-not required; LS-not required; PR-MH.	Equipment and other contents supported by access floor systems are anchored or braced to the structure independent of the access floor. (Tier 2: Sec. 13.7.7 13.6.10; Commentary: Sec. A.7.11.5)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

CF-6 Suspended Contents. HR-not required; LS-not required; PR-H.	Items suspended without lateral bracing are free to swing from or move with the structure from which they are suspended without damaging themselves or adjoining components. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.6)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

Mechanical and Electrical Equipment

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
ME-1 Fall-Prone Equipment. HR-not required; LS-H; PR-H.	Equipment weighing more than 20 lb (9.1 kg) whose center of mass is more than 4 ft (1.2 m) above the adjacent floor level, and which is not in-line equipment, is braced. (Tier 2: Sec. 13.7.1 13.7.7; Commentary: Sec. A.7.12.4)			X		
ME-2 In-Line Equipment. HR-not required; LS-H; PR-H.	Equipment installed in line with a duct or piping system, with an operating weight more than 75 lb (34.0 kg), is supported and laterally braced independent of the duct or piping system. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.5)			X		
ME-3 Tall Narrow Equipment. HR-not required; LS-H; PR-MH.	Equipment more than 6 ft (1.8 m) high with a height-to-depth or height-to-width ratio greater than 3-to-1 is anchored to the floor slab or adjacent structural walls. (Tier 2: Sec. 13.7.1 13.7.7; Commentary: Sec. A.7.12.6)			X		
ME-4 Mechanical Doors. HR-not required; LS-not required; PR-MH.	Mechanically operated doors are detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 13.6.9; Commentary: Sec. A.7.12.7)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
ME-5 Suspended Equipment. HR-not required; LS-not required; PR-H.	Equipment suspended without lateral bracing is free to swing from or move with the structure from which it is suspended without damaging itself or adjoining components. (Tier 2: Sec. 13.7.1, 13.7.7; Commentary: Sec. A.7.12.8)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
ME-6 Vibration Isolators. HR-not required; LS-not required; PR-H.	Equipment mounted on vibration isolators is equipped with horizontal restraints or snubbers and with vertical restraints to resist overturning. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.9)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
ME-7 Heavy Equipment. HR-not required; LS-not required; PR-H.	Floor supported or platform-supported equipment weighing more than 400 lb (181.4 kg) is anchored to the structure. (Tier 2: Sec. 13.7.1, 13.7.7; Commentary: Sec. A.7.12.10)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
ME-8 Electrical Equipment. HR-not required; LS-not required; PR-H.	Electrical equipment is laterally braced to the structure. (Tier 2: Sec. 13.7.7; Commentary: Sec. A.7.12.11)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
ME-9 Conduit Couplings. HR-not required; LS-not required; PR-H.	Conduit greater than 2.5 in. (64 mm) trade size that is attached to panels, cabinets, or other equipment and is subject to relative seismic displacement has flexible couplings or connections. (Tier 2: Sec. 13.7.8; Commentary: Sec. A.7.12.12)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

Piping

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
PP-1 Flexible Couplings. HR-not required; LS-not required; PR-H.	Fluid and gas piping has flexible couplings. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.2)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
PP-2 Fluid and Gas Piping. HR-not required; LS-not required; PR-H.	Fluid and gas piping is anchored and braced to the structure to limit spills or leaks. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.4)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
PP-3 C-Clamps. HR-not required; LS-not required; PR-H.	One-sided C-clamps that support piping larger than 2.5 in. (64 mm) in diameter are restrained. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.5)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
PP-4 Piping Crossing Seismic Joints. HR-not required; LS-not required; PR-H.	Piping that crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.6)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

Ducts

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
D-1 Duct Bracing. HR-not required; LS-not required; PR-H.	Rectangular ductwork larger than 6 ft2 (0.56 m2) in cross-sectional area and round ducts larger than 28 in. (711 mm) in diameter are braced. The maximum spacing of transverse bracing does not exceed 30 ft (9.2 m). The maximum spacing of longitudinal bracing does not exceed 60 ft (18.3 m). (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.2)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
D-2 Duct Support. HR-not required; LS-not required; PR-H.	Ducts are not supported by piping or electrical conduit. (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.3)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
D-3 Ducts Crossing Seismic Joints. HR-not required; LS-not required; PR-H.	Ducts that cross seismic joints or isolation planes or are connected to independent structures have couplings or other details to accommodate the relative seismic displacements. (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.4)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

Elevators

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
EL-1 Retainer Guards. HR-not required; LS-H; PR-H.	Sheaves and drums have cable retainer guards. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.1)			X		No elevator
EL-2 Retainer Plate. HR-not required; LS-H; PR-H.	A retainer plate is present at the top and bottom of both car and counterweight. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.2)			X		No elevator

EL-3 Elevator Equipment. HR-not required; LS-not required; PR-H.	Equipment, piping, and other components that are part of the elevator system are anchored. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.3)			X		No elevator
EL-4 Seismic Switch. HR-not required; LS-not required; PR-H.	Elevators capable of operating at speeds of 150 ft/min or faster are equipped with seismic switches that meet the requirements of ASME A17.1 or have trigger levels set to 20% of the acceleration of gravity at the base of the structure and 50% of the acceleration of gravity in other locations. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.4)			X		No elevator
EL-5 Shaft Walls. HR-not required; LS-not required; PR-H.	Elevator shaft walls are anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.5)			X		No elevator
EL-6 Counterweight Rails. HR-not required; LS-not required; PR-H.	All counterweight rails and divider beams are sized in accordance with ASME A17.1. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.6)			X		No elevator
EL-7 Brackets. HR-not required; LS-not required; PR-H.	The brackets that tie the car rails and the counterweight rail to the structure are sized in accordance with ASME A17.1. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.7)			X		No elevator
EL-8 Spreader Bracket. HR-not required; LS-not required; PR-H.	Spreader brackets are not used to resist seismic forces. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.8)			X		No elevator
EL-9 Go-Slow Elevators. HR-not required; LS-not required; PR-H.	The building has a go-slow elevator system. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.9)			X		No elevator

Appendix B: Concept-Level Seismic Upgrade Figures

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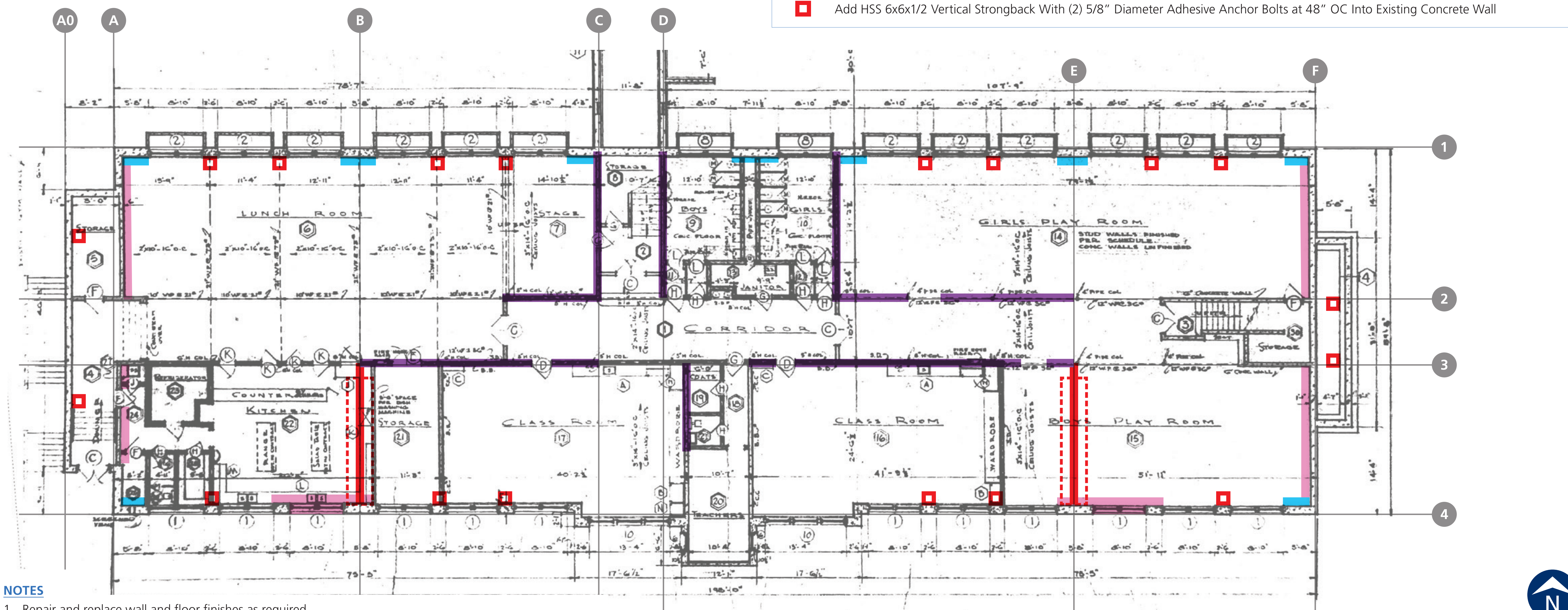
LEGEND

- 8" Masonry Wall With #5 Bars at 16" EW EF Dowel Into Concrete Footing at 16" OC, Remove Existing Stud Wall as Required
- Add 1/2" Plywood Each Side of Existing Stud Wall With 10D Nails at 2" OC at Panel Edges, Add Studs as Required to Achieve Stud Spacing of 16" OC at Sill Plate, Install 5/8" Titen HD Anchors at 16" OC
- 10" Concrete Wall With #5 at 12" OC EW EF at Each End Add Vert (6) #8 at 5" OC With #4 Ties at 3" OC
- 10" Concrete Wall With #5 at 12" OC EW Infill Window Where Occurs
- Add 2'-0" Thick X 4'-0" Wide Footing With #5 at 6" OC Long T&B & #5 at 18" OC Trans T&B
- Add HSS 6x6x1/2 Vertical Strongback With (2) 5/8" Diameter Adhesive Anchor Bolts at 48" OC Into Existing Concrete Wall



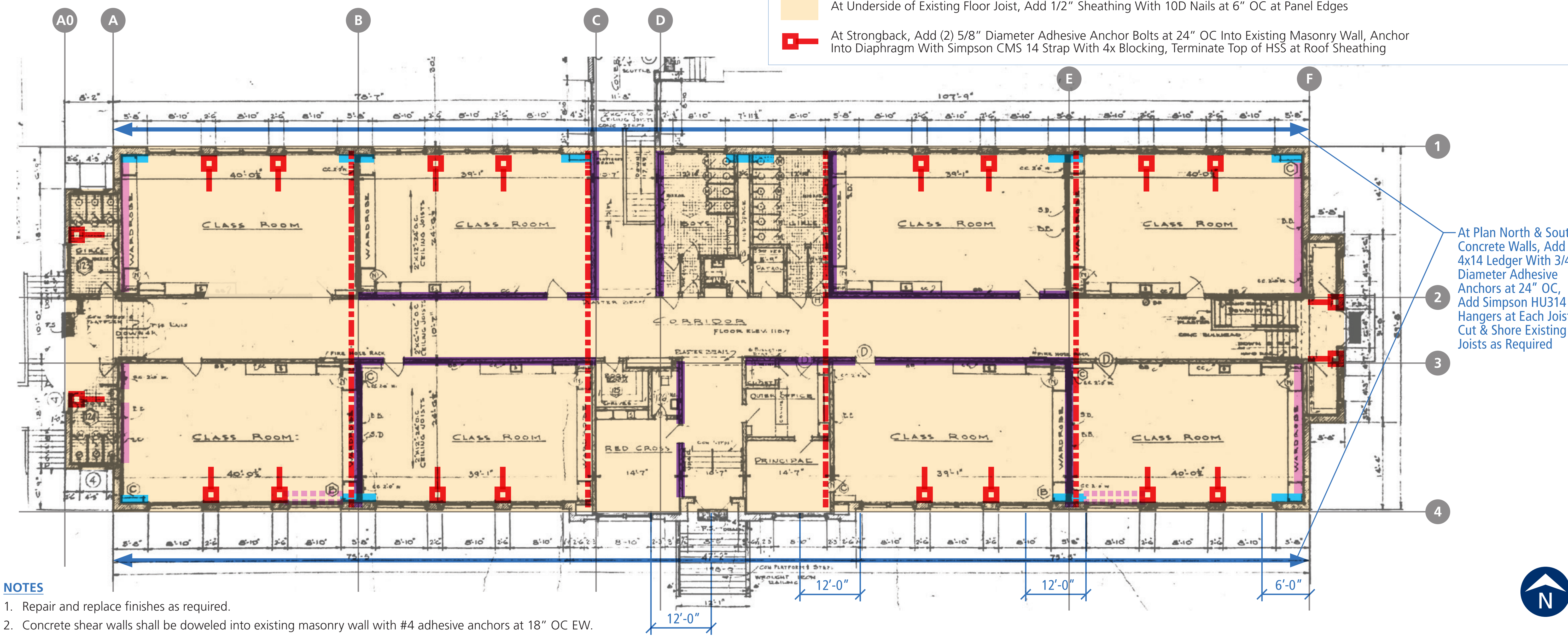
NOTES

1. Repair and replace wall and floor finishes as required.
2. Concrete shear walls shall be doweled into existing masonry wall with #4 adhesive anchors at 18" OC EW.

Figure 1 – Ground Floor Plan

LEGEND

- At Underside of Existing Floor Joist, Add L 4x4x3/8 Collector With Simpson SD 8x1.25 Screws at 3" OC Staggered Into Plywood, Add 5/8" Lag Screws, at Wood Shear Walls & 5/8" Adhesive Anchors at Masonry Walls at 16" OC Where Occurs, Provide 4x Nailer at Collectors
- Add 1/2" Plywood Both Sides of Existing Stud Wall With 10D Nails at 3" OC at Panel Edges, Add Studs as Required to Achieve Stud Spacing of 16" OC
- 10" Concrete Wall With #5 at 12" OC EW EF, at Each End Add Vert (6) #8 at 5" OC With #4 Ties at 3" OC
- 10" Concrete Wall With #5 at 12" OC EW EF, Infill Window Where Occurs
- Shear Wall Below
- At Underside of Existing Floor Joist, Add 1/2" Sheathing With 10D Nails at 6" OC at Panel Edges
- At Strongback, Add (2) 5/8" Diameter Adhesive Anchor Bolts at 24" OC Into Existing Masonry Wall, Anchor Into Diaphragm With Simpson CMS 14 Strap With 4x Blocking, Terminate Top of HSS at Roof Sheathing



NOTES

1. Repair and replace finishes as required.
2. Concrete shear walls shall be doweled into existing masonry wall with #4 adhesive anchors at 18" OC EW.

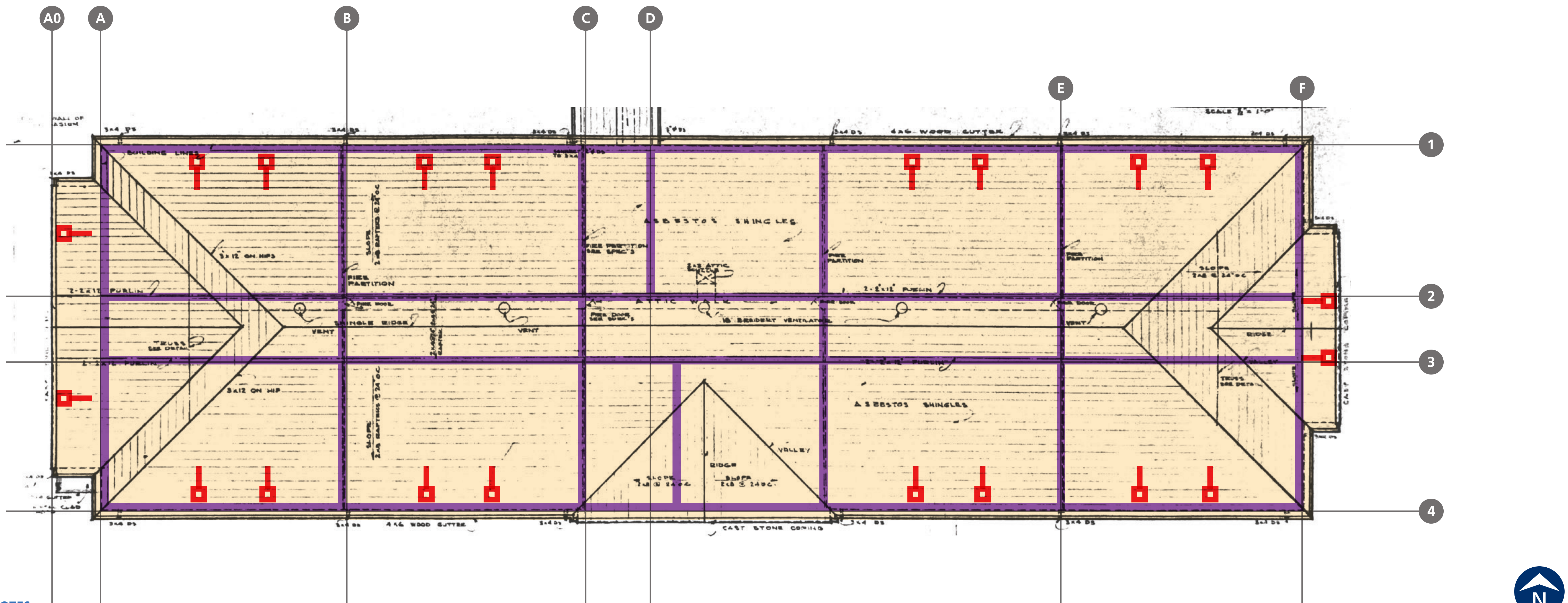
ReidMiddleton
wrk engineers STRUCTURAL & EARTHQUAKE ENGINEERING

Morton Elementary School Seismic Upgrades – Main Building
Washington State School Seismic Safety Assessments Project – Morton School District – June 2021

Figure 2 – First Floor Plan

LEGEND

- Add 2x6 Stud Wall With 1/2" Plywood Both Sides & 10D Nails at 6" OC, Terminate Wall at Roof Sheathing, Add HSS 6x3x1/4 Collector to Bottom of Wall With 5/8" Threaded Studs at 2'-0" OC, at Concrete Shear Wall Embed 5/8" Anchors 9" at 2'-0" OC
- Add 1/2" Sheathing With 10D Nails at 6" OC at Panel Edges, Typ. at Roof
- Anchor Top of Strong Back to Diaphragm With Simpson CMS 14 Strap With 4x Blocking



NOTES

1. Repair and replace roofing and shingles as required.

Figure 3 – Roof Plan

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Appendix C: Opinion of Probable Construction Costs

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PRODIMS
PROJECT MANAGEMENT SERVICES

520 Kirkland Way, Suite 301
Kirkland, WA 98033
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Name:	**Wa State School Seismic Safety Assessment Phase 2**
Second Name:	**Morton Elementary School**
Location:	**Morton, WA**
Design Phase:	**ROM Cost Estimates**
Date of Estimate:	**February 19, 2021**
Date of Revision:	**April 12, 2021/June 8, 2021**
Month of Cost Basis:	**1Q, 2021**

Morton Elementary School

Master Estimate Summary

Project Name	Construction Cost Type	Estimated Construction Cost
Morton Elementary School	Structural Costs	$2,209,313
Morton Elementary School	Non-Structural Costs	$1,767,450
TOTAL ESTIMATED CONSTRUCTION COST →		**$3,976,763**

Soft Costs	Soft Costs % Construction Cost	Estimated Soft Costs
Project Soft Cost Allowance	40.0%	**$1,590,705**
		Sum of the Above
TOTAL ESTIMATED PROJECT COST →		**$5,567,469**

Estimate Assumptions:

The ROM Construction Cost estimates are based on the Concept Design Report for the Project.
Construction Escalation is not included. Costs are current as of the month of Cost Basis noted above right.

Estimate Qualifications:

The ROM estimates are not be relied on solely for proforma development and financial decisions.
Further design work is required to determine construction budgets.
All Buildings Estimated to the 5' foot line for Utilities, All Sitework is estimated to go with any combination of the buildings and alternatives.
The ROM estimates do not include any Hazardous Material Abatement/Disposal.
For Construction Cost Markups they are additive, not cumulative. Percentages are added to the previous subtotal rather than the direct cost subtotal.
Owner Soft Costs Allowance are: A/E design fees, QA/QC, Project Administration, Owners Project Contingency, Average Washington State Sale Tax and
Estimated labor is based on an 8 hour per day shift 5 days a week. Accelerated schedule work of overtime has not been included.
Estimated labor is based on working on unoccupied facility without phased construction.
Estimate is based on a competitive public bid with at least 3 bona fide submitted and unrescinded general contractor bids.
Estimate is based on a competitive public bid with a minimum 6 week bidding schedule and no significant addendums within 2 weeks of bid opening.
State of Washington General Contractor/ Construction Manager (GC/CM) contracts typically raises construction costs. It is Not Included in this estimate.
Estimated construction cost is for the entire project. This estimate is not intended to be used for other projects.
Please consult the cost estimator for any modifications to this estimate. Unilaterally adding and deleting markups, scope of work, schedule, specifications, plans and bid forms could incorrectly restate the project construction cost.
Construction reserve contingency for change orders is not included in the estimate.
Sole source supply of materials and/ or installers typically results in a 40% to 100% premium on costs over open specifications.

PRODIMS

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Structural Costs

Name:	Wa State School Seismic Safety Assessment Phase 2	Areas	sqft
Second Name:	Morton Elementary School	Building Area	25,200
Location:	Morton, WA		
Design Phase:	ROM Cost Estimates		
Date of Estimate:	February 19, 2021		
Date of Revision:	April 12, 2021/June 8, 2021		
Month of Cost Basis:	1Q, 2021	Total Areas	25,200

Morton Elementary School

Construction Cost Estimate

Subtotal Direct Cost From the Estimate Detail Below $ 1,500,978

	Percentage of Previous Subtotal	Amount	Running Subtotal
Scope Contingency	10.0%	$ 150,098	$ 1,651,075
General Conditions	10.0%	$ 150,098	$ 1,801,173
Home Office Overhead	5.0%	$ 75,049	$ 1,876,222
Profit	6.0%	$ 90,059	$ 1,966,281
0	12.4%	$ 243,032	$ 2,209,313
Washington State Sales Tax - Included in Soft Costs			

Total Markups Applied to the Direct Cost 47.19%
Markups are multiplied on each subtotal- They are not multiplied from the direct cost

		$/sqft
TOTAL ESTIMATED CONSTRUCTION COST--	**$ 2,209,313**	**$ 87.67**
-20% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE --	**$ 1,767,450**	**$ 70.14**
+50% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE --	**$ 3,313,969**	**$ 131.51**

Please see the Master Summary for Assumptions and Qualifications for ROM Cost Estimates

Direct Cost of Construction

WBS	Description	Quantity	U of M	Labor	Labor Total	Material	Material Total	Equipment	Equipment Total	Total $/U of M	Direct Cost
1 - Seismic Retrofit											
Foundations											
	Spread Footings System- Excavation, Backfill, Formwork, Concrete, Reinforcing and Detailing	15.0	cuyd	$ 716.25	$ 10,743.75	$ 238.75	$ 3,581.25	$ 57.30	$ 859.50	$ 1,012.30	$ 15,184.50
Substructure											
	Demo/Reinstall Slab on Grade System for New Footings Installation.	215	sqft	$ 9.90	$ 2,128.50	$ 8.10	$ 1,741.50	$ 1.08	$ 232.20	$ 19.08	$ 4,102.20
Superstructure											
Upper Floor Systems											
	Shotcrete 10" Thick Shear Wall with Rebar EW + EF Including Drill and Epoxy in Rebar	20.0	cuyd	$ 521.95	$ 10,439.00	$ 193.05	$ 3,861.00	$ 42.90	$ 858.00	$ 757.90	$ 15,158.00
	Shotcrete 10" Thick Shear Wall with Rebar Including Drill and Epoxy in Rebar	57.0	cuyd	$ 474.50	$ 27,046.50	$ 175.50	$ 10,003.50	$ 39.00	$ 2,223.00	$ 689.00	$ 39,273.00
	Install Tube Steel Columns HSS 6x6x1/2 for Strongback Support Fasten to Concrete Wall with 2 Each 5/8" Epoxy Anchors at 48" o.c.	7.19	ton	$ 5,368.00	$ 38,589.21	$ 3,432.00	$ 24,671.79	$ 528.00	$ 3,795.66	$ 9,328.00	$ 67,056.66
	Upgrade Shearwall with 1/2" Plywood Sheathing at Each Face with Studs as Required with Titen Hold Down Anchors at 16" o.c. Sill Bolts - Remove GWB and Reinstall	3,210	sqft	$ 7.80	$ 25,038.00	$ 4.20	$ 13,482.00	$ 0.72	$ 2,311.20	$ 12.72	$ 40,831.20
	8" CMU Masonry Wall with Rebar EW & EF with Dowels into New Footing	590	sqft	$ 15.18	$ 8,956.20	$ 6.82	$ 4,023.80	$ 1.32	$ 778.80	$ 23.32	$ 13,758.80
	Install New 1/2" Plywood Directly to Bottom of Second Floor Joists	14,000	sqft	$ 1.74	$ 24,304.00	$ 1.06	$ 14,896.00	$ 0.17	$ 2,352.00	$ 2.97	$ 41,552.00
	Install Angle 4x4x3/8with SDS Screws, 4x Nailer and Add 5/8" Lags at Wood Stud or 5/8" Epoxy Anchor at CMU Walls	377	lnft	$ 22.75	$ 8,576.75	$ 12.25	$ 4,618.25	$ 2.10	$ 791.70	$ 37.10	$ 13,986.70
Roof Systems											
	Shotcrete 10" Thick Shear Wall with Rebar EW + EF Including Drill and Epoxy in Rebar	23.0	cuyd	$ 521.95	$ 12,004.85	$ 193.05	$ 4,440.15	$ 42.90	$ 986.70	$ 757.90	$ 17,431.70

WBS	Description	Quantity	U of M	Labor	Labor Total	Material	Material Total	Equipment	Equipment Total	Total $/U of M	Direct Cost
	Shotcrete 10" Thick Shear Wall with Rebar Including Drill and Epoxy in Rebar	20.0	cuyd	$ 474.50	$ 9,490.00	$ 175.50	$ 3,510.00	$ 39.00	$ 780.00	$ 689.00	$ 13,780.00
	Install Tube Steel Columns HSS 6x6x1/2 for Strongback Support Fasten to Concrete Wall with 5/8" Epoxy Bolts 24" o.c. with CMS with 4X Blocking at Roof Anchorage	10.65	ton	$ 5,551.00	$ 59,118.15	$ 3,549.00	$ 37,796.85	$ 546.00	$ 5,814.90	$ 9,646.00	$ 102,729.90
	Upgrade Shearwall with 1/2" Plywood Sheathing at Each Face with Studs as Required - Remove GWB and Reinstall	4,305	sqft	$ 6.18	$ 26,583.38	$ 3.33	$ 14,314.13	$ 0.57	$ 2,453.85	$ 10.07	$ 43,351.35
	2x6 Wood Stud Wall at Attic Spaces with 1/2" Plywood Sheathing at Each Face	9,800	sqft	$ 10.23	$ 100,254.00	$ 0.77	$ 7,546.00	$ 0.66	$ 6,468.00	$ 11.66	$ 114,268.00
	Install Tube Steel Collector at Attic HSS 6x36x1/4 Fasten to Concrete Slab with 5/8" Epoxy Bolts 24" o.c.	5.09	ton	$ 5,368.00	$ 27,320.44	$ 3,432.00	$ 17,467.16	$ 528.00	$ 2,687.26	$ 9,328.00	$ 47,474.86
	4x14 Ledger with 3/4" Anchor Bolts at 24" o.c. and Hangars at Modified Joists with Temporary Shoring	377	lnft	$ 26.95	$ 10,160.15	$ 8.05	$ 3,034.85	$ 2.10	$ 791.70	$ 37.10	$ 13,986.70
	Add 1/2" Plywood Sheathing at Existing Roof with 10d nails at 6" o.c.	15,650	sqft	$ 0.86	$ 13,427.70	$ 0.46	$ 7,230.30	$ 0.08	$ 1,239.48	$ 1.40	$ 21,897.48
Roofing System											
	Remove Roofing System Down to Roof Deck	15,650	sqft	$ 4.04	$ 63,186.88	$ 0.21	$ 3,325.63	$ 0.26	$ 3,990.75	$ 4.51	$ 70,503.25
	New Shingle Roofing System with R-38 Rigid Insulation, Flashing and Trim and Downspout Roof Drainage System	15,650	sqft	$ 10.80	$ 169,020.00	$ 11.70	$ 183,105.00	$ 1.35	$ 21,127.50	$ 23.85	$ 373,252.50
Interior Wall/Door/Casework/Specialties Systems											
	Remove and Reinstall Floor Finish Systems-Allow 100% of the Floor Area	25,200	sqft	$ 3.01	$ 75,776.40	$ 1.84	$ 46,443.60	$ 0.29	$ 7,333.20	$ 5.14	$ 129,553.20
	Remove and Reinstall Wall Finish Systems-Allow 1050% of the Floor Area	25,200	sqft	$ 2.79	$ 70,308.00	$ 1.71	$ 43,092.00	$ 0.27	$ 6,804.00	$ 4.77	$ 120,204.00
	Remove Ceiling and Reinstall New ACT Ceiling Systems - Allow 100% of the Floor Area	25,200	sqft	$ 4.22	$ 106,243.20	$ 2.58	$ 65,116.80	$ 0.41	$ 10,281.60	$ 7.21	$ 181,641.60
Subtotal of the Direct Cost of Construction				**Morton Elementary School**							**$ 1,500,978**

PRODIMS

520 Kirkland Way, Suite 301
Kirkland, WA 98033
Phone: 425-828-0500 Fax: 425-828-0700
www.prodims.com

Non-Structural Costs

Name:	Wa State School Seismic Safety Assessment Phase 2	Areas	sqft
Second Name:	Morton Elementary School	Building Area	25,200
Location:	Morton, WA		
Design Phase:	ROM Cost Estimates		
Date of Estimate:	February 19, 2021		
Date of Revision:	April 12, 2021/June 8, 2021		
Month of Cost Basis:	1Q, 2021	Total Areas	25,200

Morton Elementary School

Construction Cost Estimate

Subtotal Direct Cost From the Estimate Detail Below $ 1,200,782

	Percentage of Previous Subtotal	Amount	Running Subtotal
Scope Contingency	10.0%	$ 120,078	$ 1,320,860
General Conditions	10.0%	$ 120,078	$ 1,440,938
Home Office Overhead	5.0%	$ 60,039	$ 1,500,978
Profit	6.0%	$ 72,047	$ 1,573,025
0	12.4%	$ 194,426	$ 1,767,450
Washington State Sales Tax - Included in Soft Costs			

Total Markups Applied to the Direct Cost 47.19%
Markups are multiplied on each subtotal- They are not multiplied from the direct cost

		$/sqft
TOTAL ESTIMATED CONSTRUCTION COST--	**$ 1,767,450**	**$ 70.14**
-20% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE --	**$ 1,413,960**	**$ 56.11**
+50% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE --	**$ 2,651,176**	**$ 105.21**

Please see the Master Summary for Assumptions and Qualifications for ROM Cost Estimates

Direct Cost of Construction

WBS	Description	Quantity	U of M	Labor	Labor Total	Material	Material Total	Equipment	Equipment Total	Total $/U of M	Direct Cost
	2- Non- Structural Demo/Restoration*										
	M/E/P/FP Systems										
	Mechanical/Electrical/Fire Protection Systems *	25,200	sqft	$ 24.72	$ 623,047.30	$ 20.23	$ 509,765.98	$ 2.70	$ 67,968.80	$ 47.65	$ 1,200,782.08
	*Allows 80 percent of existing nonstructural systems M/E/P/FP require upgrades/replacement.										
	Subtotal of the Direct Cost of Construction			**Morton Elementary School**							**$ 1,200,782**

Appendix D: Earthquake Performance Assessment Tool (EPAT) Worksheet

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Washington Schools Earthquake Performance Assessment Tool (EPAT) RESULTS SUMMARY		
District Name	Morton	**Existing Building Life Safety Risk & Priority for Retrofit or Replacement**
School Name	Morton Elementary School	
Building Name	Main Building	Very High

Building Data		
HAZUS Building Type	C2	Concrete Shear Walls
Year Built	1948	These parameters determine the capacity of the existing building to withstand earthquake forces.
Building Design Code	<1973 UBC	
Existing Building Code Level	Pre	
Geographic Area	Puget Sound	
Severe Vertical Irregularity	No	Buildings with irregularities have greater earthquake damage than otherwise similar buildings that are regular.
Moderate Vertical Irregularity	No	
Plan Irregularity	No	

Seismic Data		
Earthquake Ground Shaking Hazard Level	High	Frequency and severity of earthquakes at this site
Percentile S_s Among WA K-12 Campuses	40%	Earthquake ground shaking hazard is higher than 40% of WA campuses.
Site Class (Soil or Rock Type)	C	Very Dense Soil and Soft Rock
Liquefaction Potential	Moderate to High	Liquefaction increases the risk of major damage to a building
Combined Earthquake Hazard Level	Very High	Earthquake ground shaking and liquefaction potential

Severe Earthquake Event (Design Basis Earthquake Ground Motion)[1]

Building State	**Building Damage Estimate[2]**	**Probability Building is not Repairable[3]**	**Life Safety[4] Risk Level**	**Most Likely Post-Earthquake Tagging[5]**
Existing Building	66%	65%	Very High	Red
Life Safety Retrofit Building	13%	6.0%	Very Low	Green
Current Code Building	10.0%	3.7%	Very Low	Green

1. 2/3rds of the 2% in 50 year ground motion
2. Percentage of building replacement value.
3. Probability building is in the Extensive or Complete damage states. For existing buildings, the probability that the building is not economically repairable may be higher: some buildings in the Moderate Damage state are also likely to be demolished.
4. Based on probability of Complete Damage State.
5. Most likely post-earthquake damage state per ATC-20.

Source for the Data Entered into the Tool	
Building Evaluated By:	DNR, Reid Middleton
Person(s) Who Entered Data in EPAT:	Brian Matsumoto, Reid Middleton
User Overrides of Default Parameters:	Building Design Code Year, Latitude, Longitude, Site Class, Liquefaction, Geographic Region

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Appendix E: Existing Drawings

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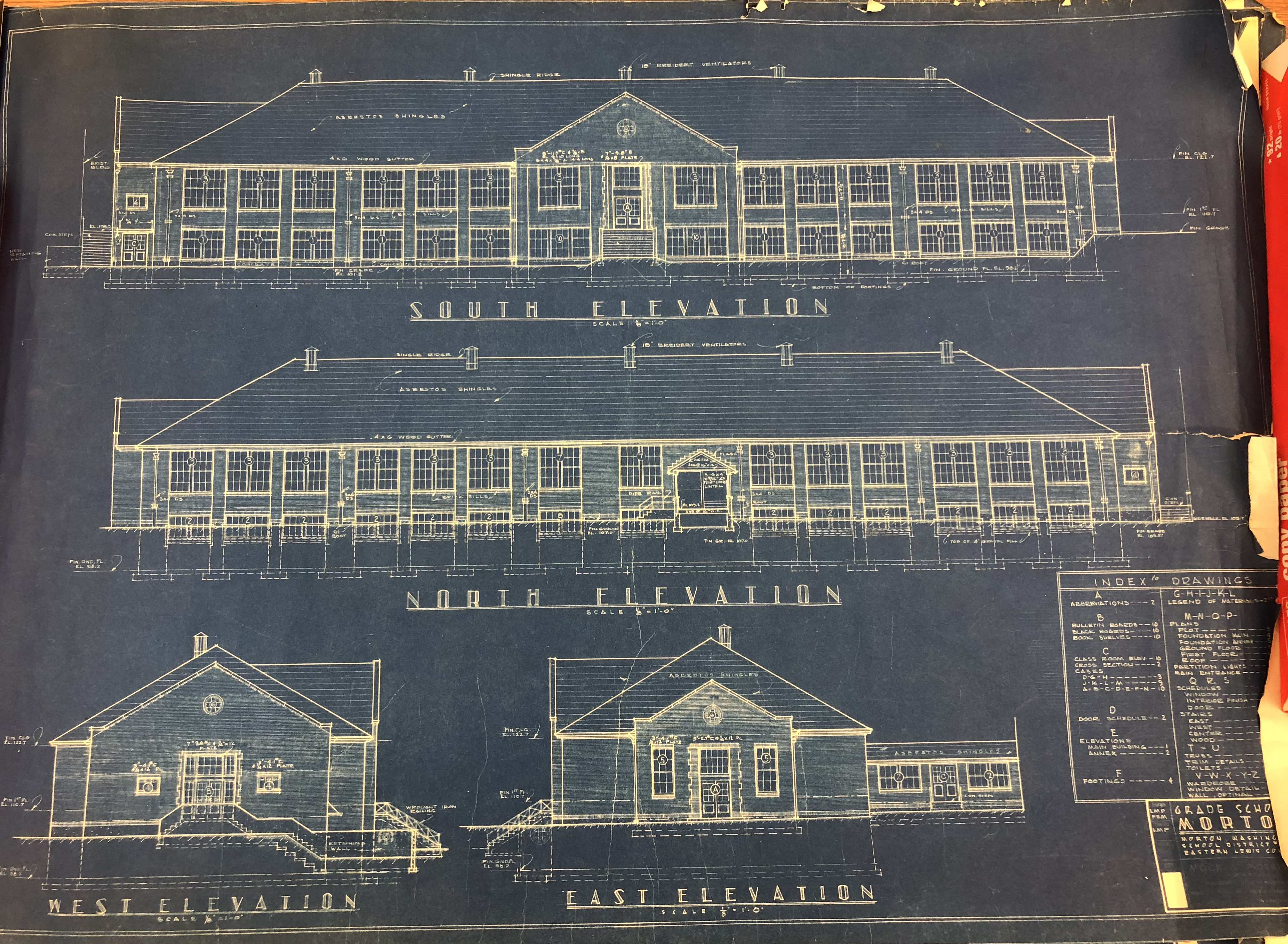

SHINGLE RIDGE
18" BREIDERT VENTILATORS
ASBESTOS SHINGLES
4X6 WOOD GUTTER
BRICK SILLS
FIN. GROUND FL. EL. 98.2
BOTTOM OF FOOTINGS
SOUTH ELEVATION
SCALE 1/8"=1'-0"
SINGLE RIDGE
18" BREIDERT VENTILATORS
ASBESTOS SHINGLES
4X6 WOOD GUTTER
PIPE RAIL
BRICK SILLS
TOP OF 4" GRAVEL FILL
FIN. GND. FL. EL. 98.2
NORTH ELEVATION
SCALE 1/8"=1'-0"
WROUGHT IRON RAILING
RETAINING WALL
WEST ELEVATION
SCALE 1/8"=1'-0"
ASBESTOS SHINGLES
ASBESTOS SHINGLES
EAST ELEVATION
SCALE 1/8"=1'-0"
INDEX to DRAWINGS
A
ABBREVIATIONS --- 2
B
BULLETIN BOARDS --- 10
BLACK BOARDS ----- 10
BOOK SHELVES ----- 10
C
CLASS ROOM ELEV. - 10
CROSS SECTION ----- 2
CASES
D-G-H --------- 3
J-K-L-M ------- 9
A-B-C-D-E-F-N - 10
D
DOOR SCHEDULE -- 2
E
ELEVATIONS
MAIN BUILDING --- 1
ANNEX -------- 2
F
FOOTINGS ------- 4
G-H-I-J-K-L
LEGEND OF MATERIALS - 2
M-N-O-P-
PLANS
PLOT
FOUNDATION MAIN
FOUNDATION ANNEX
GROUND FLOOR
FIRST FLOOR
ROOF
PARTITION LIGHTS
MAIN ENTRANCE
Q R S
SCHEDULES
WINDOW
INTERIOR FINISH
DOOR
STAIRS
EAST
WEST
CENTER
WOOD
T - U
TRUSS
TRIM DETAILS
TOILETS
V-W-X-Y-Z
WARDROBE
WINDOW DETAIL
WALL, OPTINAL
LMP
FEM
LMP
GRADE SCHO
MORTO
MORTON WASHING
SCHOOL DISTRICT
EASTERN LEWIS CO

ASBESTOS SHINGLES
2"x6" RAFTERS 24" O.C.
2"x12" CEILING JOISTS 24" O.C.
2"x4" LOOKOUT
BLOCKING
PICTURE MOLD
2ND STORY HEAD
WOOD ANNEX STEPS
FIN. CLASS RM FLOOR
CORRIDOR PARTITION
FIN CORRIDOR FLOOR
SOLID BRIDGING CUT BETWEEN JOISTS
PLASTER
18" BRICK PIER
2ND STORY JAMB
TYPICAL MULLION
BRICK SILL
FACE OF BRICK PIER
EXTERIOR FACE OF BRICK PIER
FINISH FLOOR
INSULATION
2"x14" JOISTS-16" O.C.
PLASTER BOARD
INSULATING BOARD
CAULK
1ST STORY HEAD
TYPICAL FRAMING DETAILS
METAL LATH & PLASTER
GROUND FLOOR JAMB
FLOOR CONSTRUCTION
OPTIONAL WALL CONSTRUCTION
SCALE 1½"=1'-0"
TYPICAL SILL
CONCRETE AT GROUND FLOOR
BRICK AT FIRST FLOOR
SEE FLOOR PLANS
17" BRICK PIER
1ST STORY JAMB
MEETING RAIL
MUNTIN
GRADE SCHOOL
MORTON
MORTON WASHINGTON
SCHOOL DISTRICT # 214
EASTERN LEWIS COUNTY
MOCK & MORRISON
574

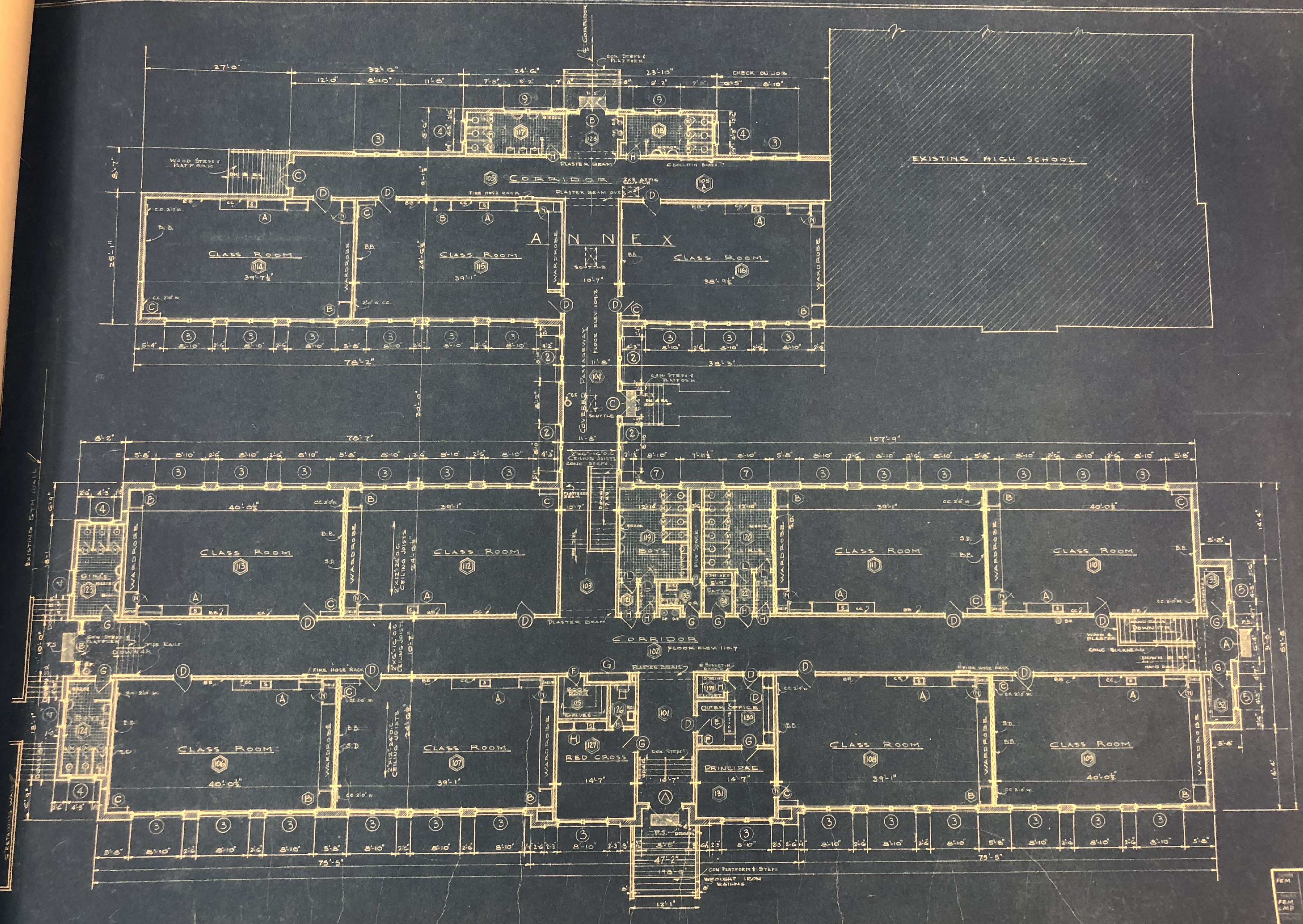
MINERAL SURFACE BUILT UP ROOF
4x6 GUTTER
3x4 DS
2x8 ATTIC SCUTTLE
FIRE PARTITION
FIRE DOOR
ATTIC WALK
RIDGE
18" BREIDERT VENT
ASBESTOS SHINGLES
METAL COVERED HOOD
EAST WALL OF GYMNASIUM
BUILDING LINES
3x12 ON HIPS
2-2x12 PURLIN
TRUSS SEE DETAIL
SHINGLE RIDGE
VENT
18 BREIDERT VENTILATOR
4x6 WOOD GUTTER
VALLEY
CAST STONE COPING
3x12 ON HIP
WEST STAIRS
SCALE 1/2"=1'-0"
PLASTER
CEMENT BASE
ROOM 123 & 124 FLOOR SLAB
ROOF PLAN
SCALE 1/8"=1'-0"
GRADE SCHOOL
MORTON
MORTON WASHINGTON SCHOOL DISTRICT #214 EASTERN LEWIS COUNTY
7

NORTH ELEVATION ~ ANNEX
SCALE 1/8"=1'-0"
WEST ELEV. ANNEX
SOUTH ELEVATION ~ ANNEX
SCALE 1/8"=1'-0"
ASBESTOS SHINGLES
4x6 WOOD GUTTER
CLASS ROOM
CORRIDOR
BOYS PLAY ROOM
GIRLS PLAY ROOM
MAIN BUILDING
ANNEX
CROSS SECTION
SCALE 1/8"=1'-0"
WINDOW SCHEDULE
DESCRIPTION
NO. LIGHTS
SIZE LIGHTS
ABBREVIATIONS USED
B.B. BLACK BOARD
C.C. CORK CARPET
C.I. CAST IRON
D.F. DRINKING FOUNTAIN
D.S. DOWN SPOUT
F.S. FOOT SCRAPER
M.C. MEDICINE CABINET
S. SINK
S.S. SLOP SINK
S.D. SOUND DEADENING
CONC. CONCRETE
LEGEND of MATERIAL
BRICK
METAL
CONCRETE
PLASTER
EARTH
WOOD
HOLLOW TILE
EXISTING WORK
DOOR SCHEDULE
SCALE 1/4"=1'-0"
INTERIOR FINISH SCHEDULE
ABBREVIATIONS USED
GROUND FLOOR
FIRST FLOOR
ROOM
FLOOR
DADO
WALL
TRIM
GRADE SCHOOL
MORTON
MORTON, WASHINGTON

EXCAVTION PLAN
SCALE 1/16" = 1'-0"

FOUNDATION PLAN
GRADE SCHOOL
MORTON
TYPICAL CONC FOOTING UNDER ALL STUD PARTITIONS GROUND FLOOR


ANNEX
TRUSS DETAIL
LUNCH ROOM
STAGE
STORAGE
BOYS
GIRLS
JANITOR
GIRLS PLAY ROOM
CORRIDOR
KITCHEN
CLASS ROOM
CLASS ROOM
BOYS PLAY ROOM
TEACHERS
GROUND FLOOR PLAN
GRADE SCHOOL
MORTON
MORTON, WASHINGTON
SCHOOL DISTRICT
EASTERN LEWIS CO.
5



FIRST FLOOR PLAN

SCALE 1/8" = 1'-0"

FEM

FEM
LMP

GRADE SCHOOL 574

MORTON

MORTON, WASHINGTON
SCHOOL DISTRICT #214
EASTERN LEWIS COUNTY

MOCK & MORRISON

C 1

Appendix F: FEMA E-74 Nonstructural Seismic Bracing Excerpts

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Life Safety Systems

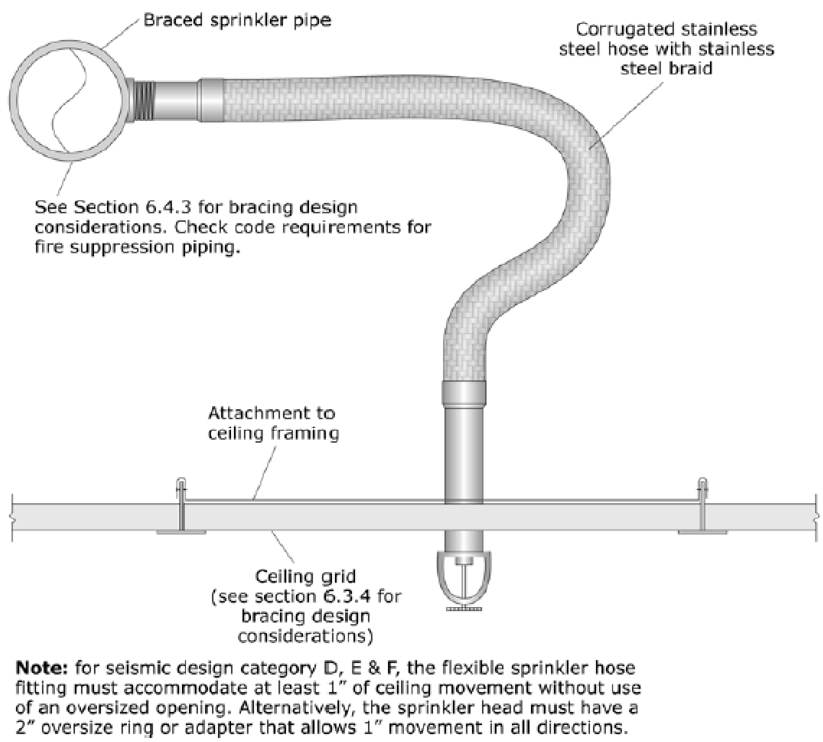


Figure G-1. Flexible Sprinkler Drop.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

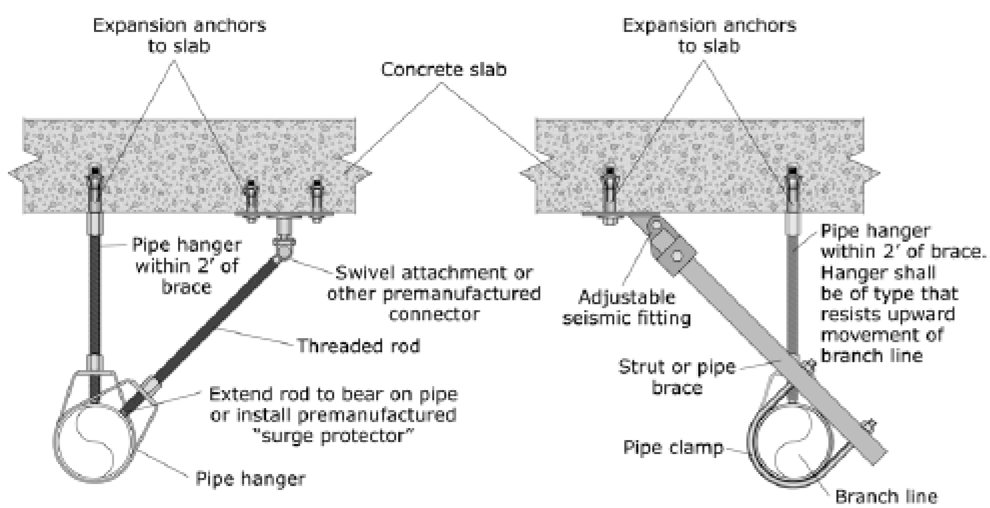


Figure G-2. End of Line Restraint.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

Partitions

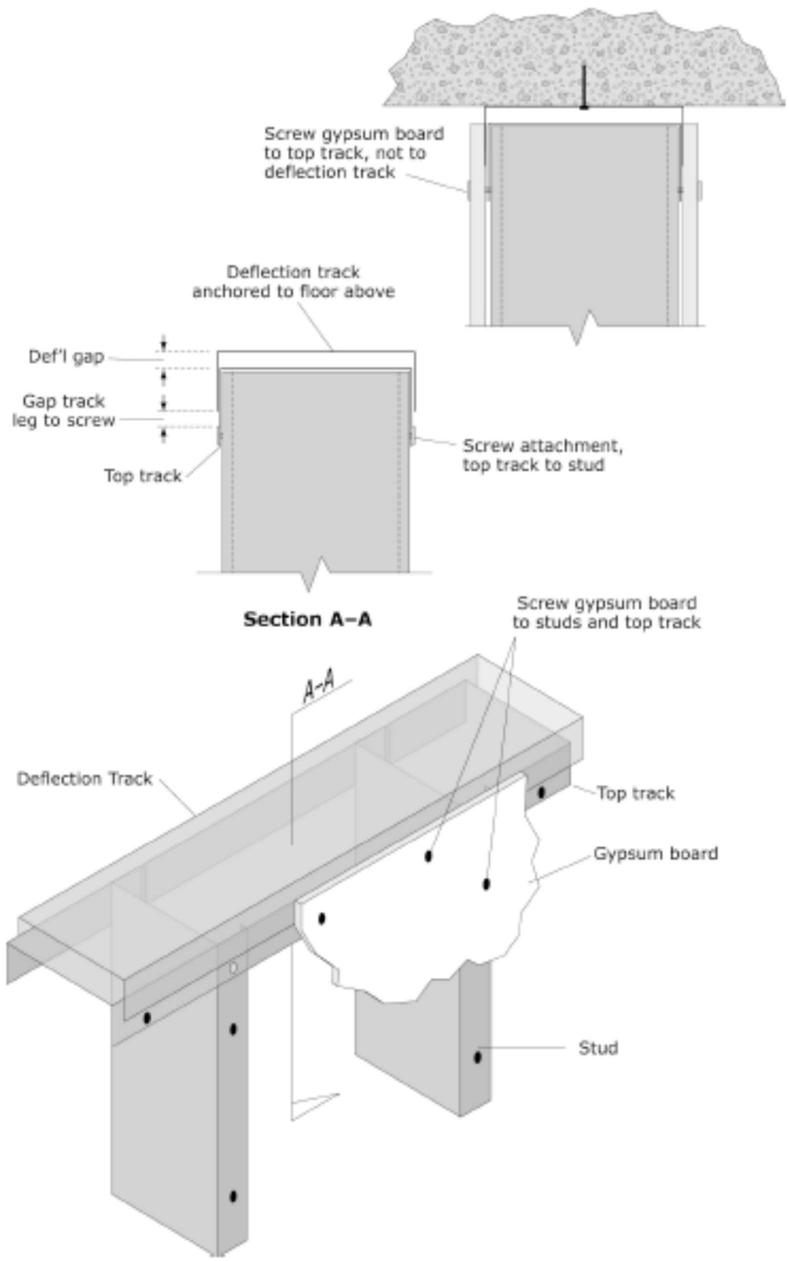


Figure G-3. Mitigation Schemes for Bracing the Tops of Metal Stud Partitions Walls.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

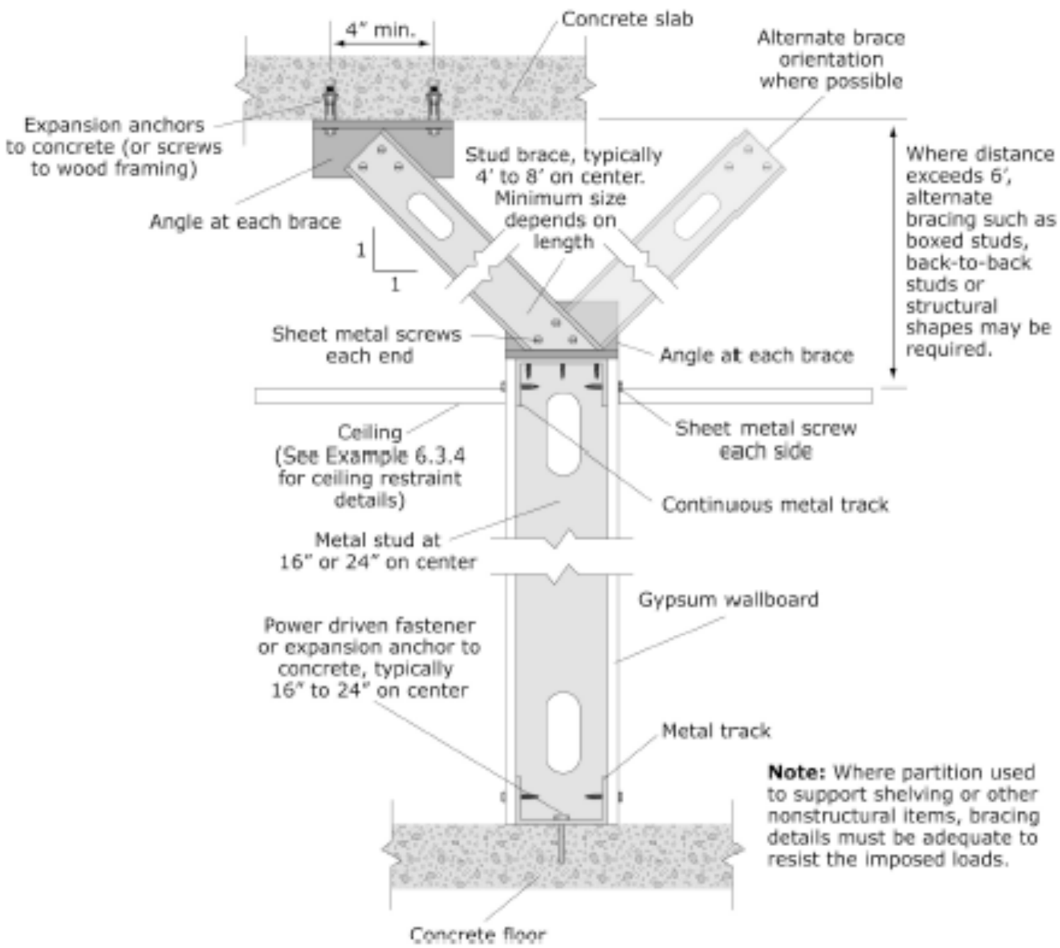


Figure G-4. Mitigation Schemes for Bracing the Tops of Metal Stud Partitions Walls.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

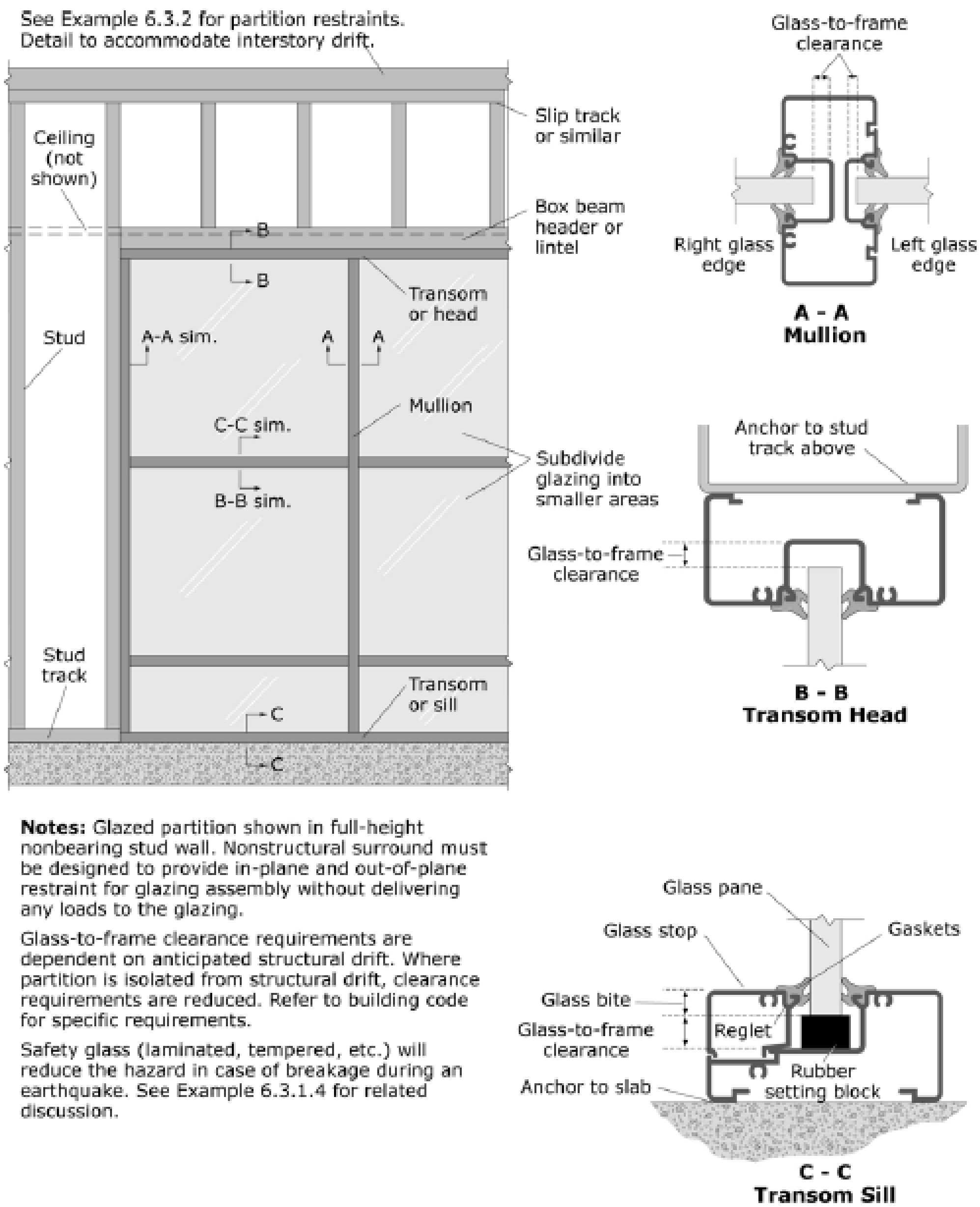


Figure G-5. Full-height Glazed Partition.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

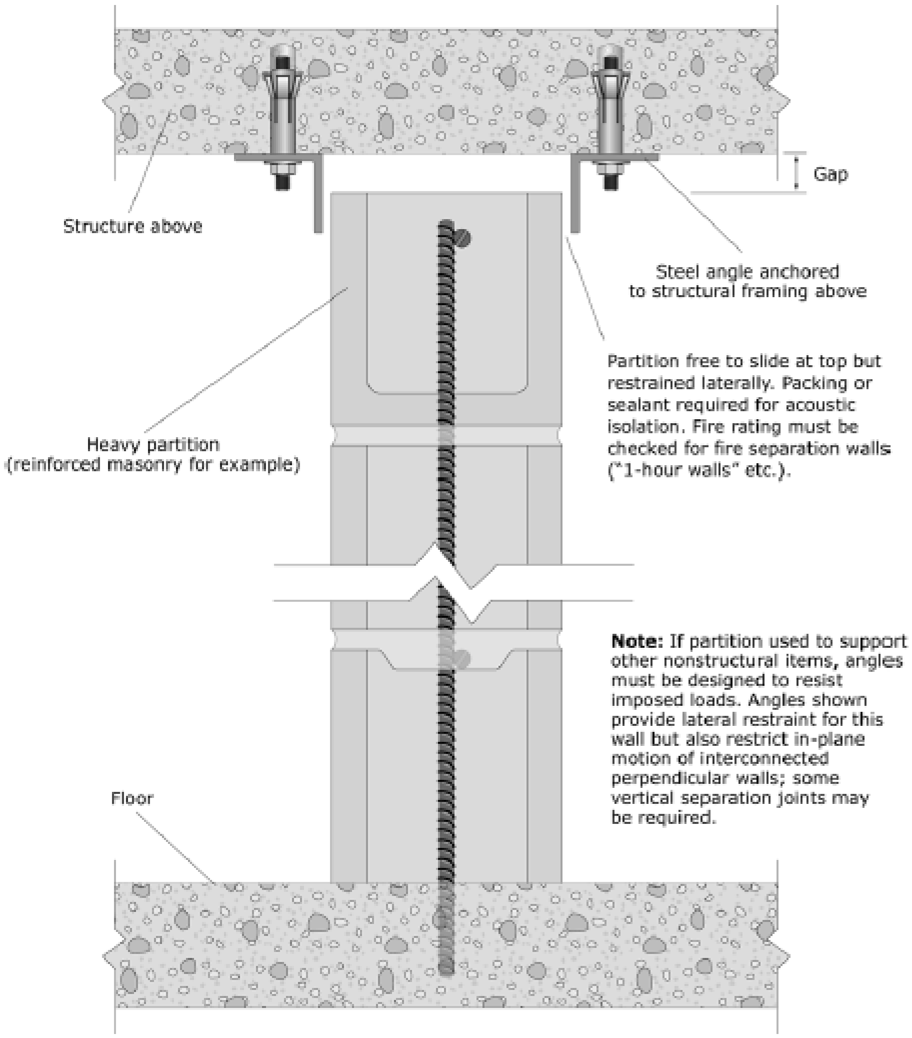


Figure G-6. Full-height Heavy Partition.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

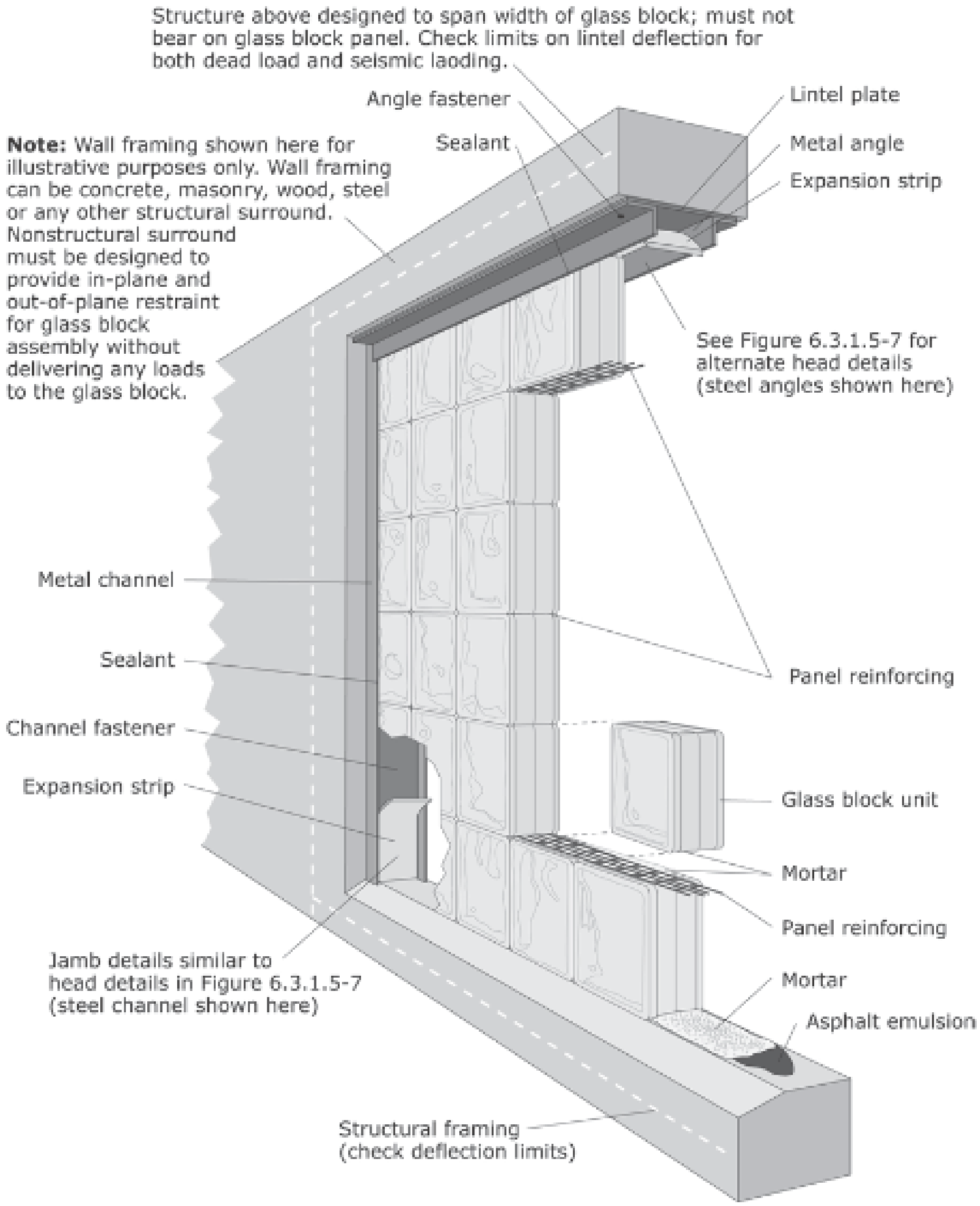


Figure G-7. Typical Glass Block Panel Details.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

Ceilings

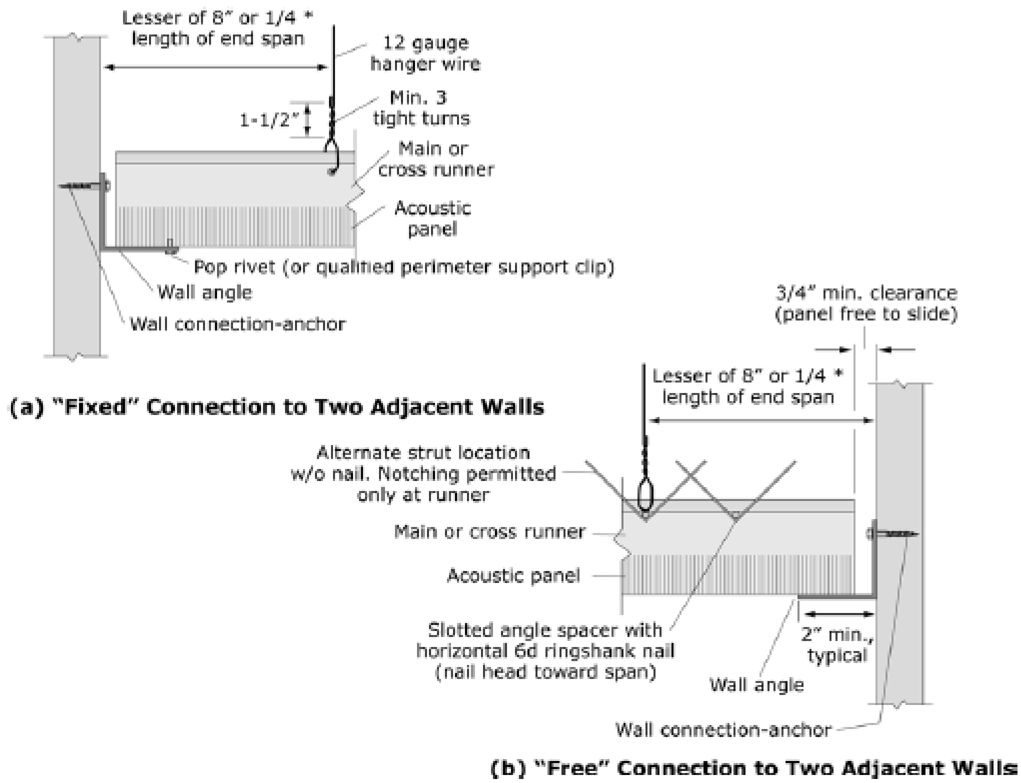
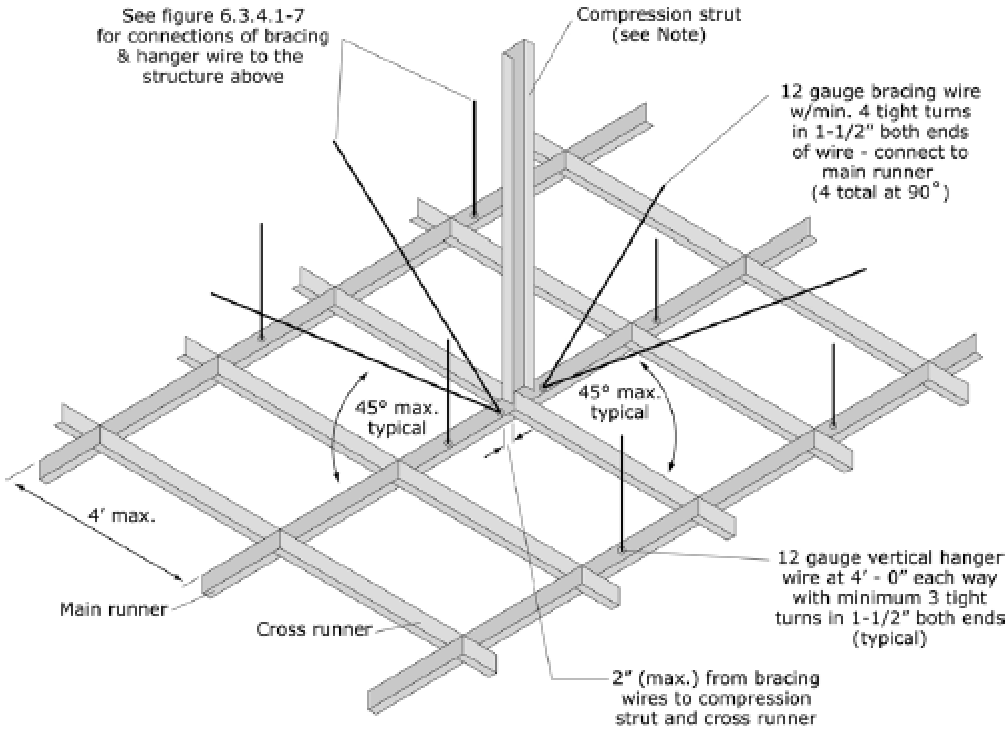


Figure G-8. Suspension System for Acoustic Lay-in Panel Ceilings – Edge Conditions.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



Note: Compression strut shall not replace hanger wire. Compression strut consists of a steel section attached to main runner with 2 - #12 sheet metal screws and to structure with 2 - #12 screws to wood or 1/4" min. expansion anchor to structure. Size of strut is dependent on distance between ceiling and structure (l/r ≤ 200). A 1" diameter conduit can be used for up to 6', a 1-5/8" X 1-1/4" metal stud can be used for up to 10'

Per DSA IR 25-5, ceiling areas less than 144 sq. ft, or fire rated ceilings less than 96 sq. ft., surrounded by walls braced to the structure above do not require lateral bracing assemblies when they are attached to two adjacent walls. (ASTM E580 does not require lateral bracing assemblies for ceilings less than 1000 sq. ft.; see text.)

Figure G-9. Suspension System for Acoustic Lay-in Panel Ceilings – General Bracing Assembly.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

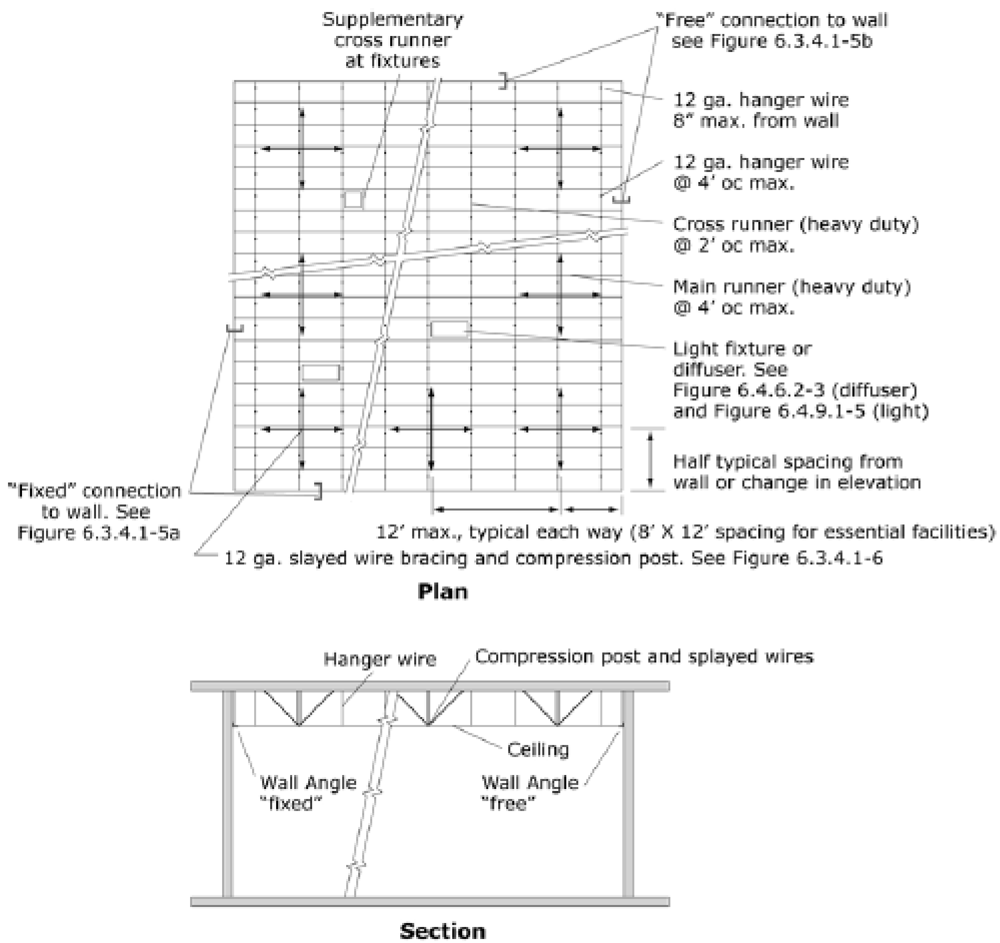


Figure G-10. Suspension System for Acoustic Lay-in Panel Ceilings – General Bracing Layout.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

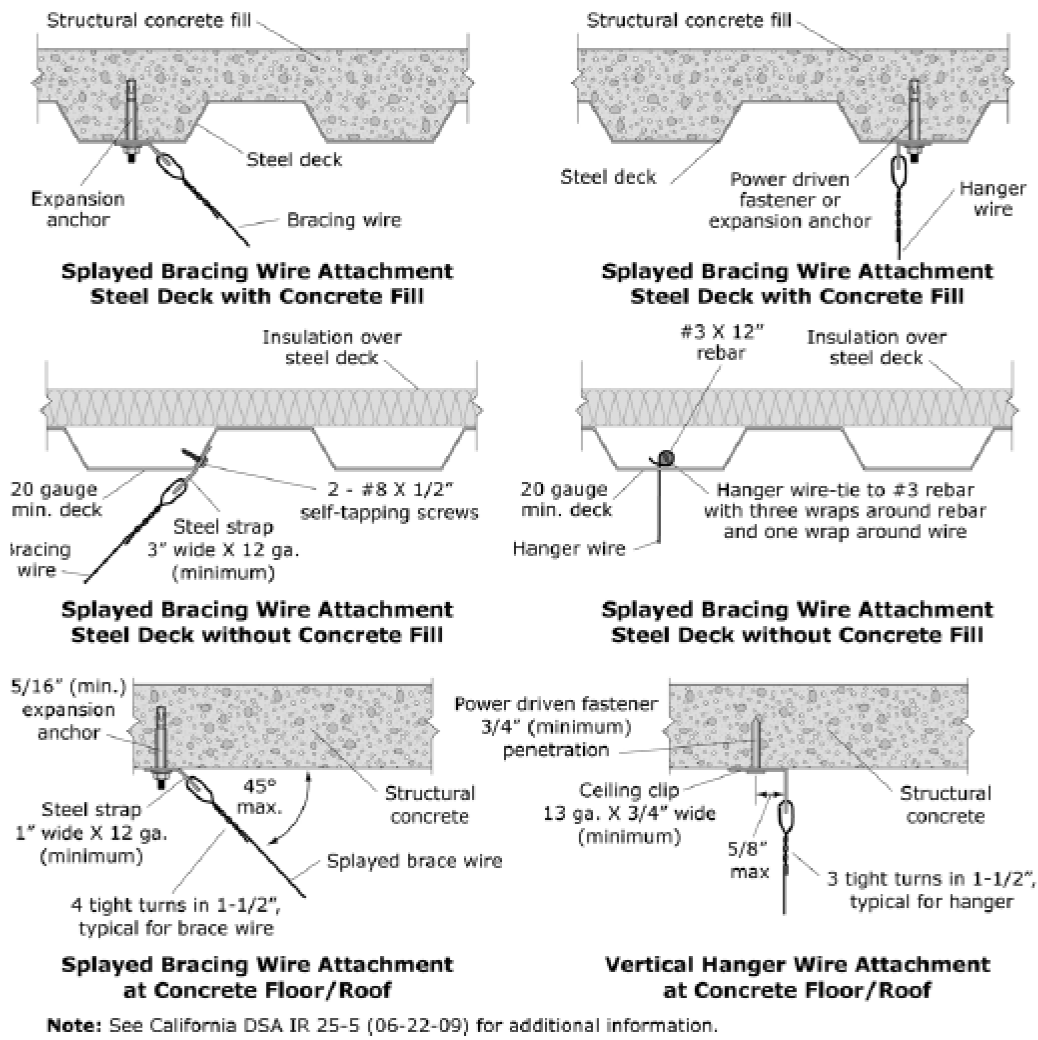
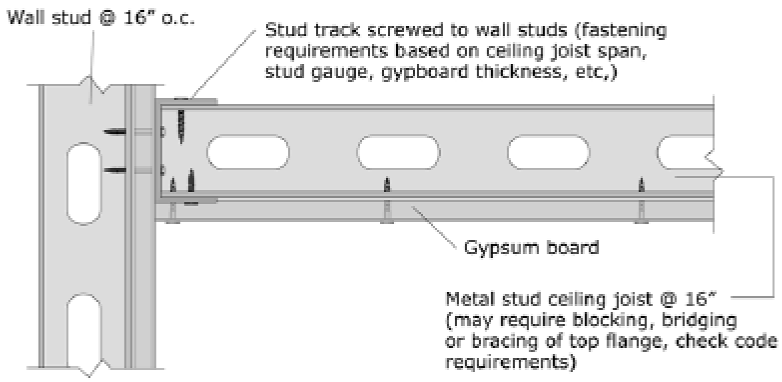
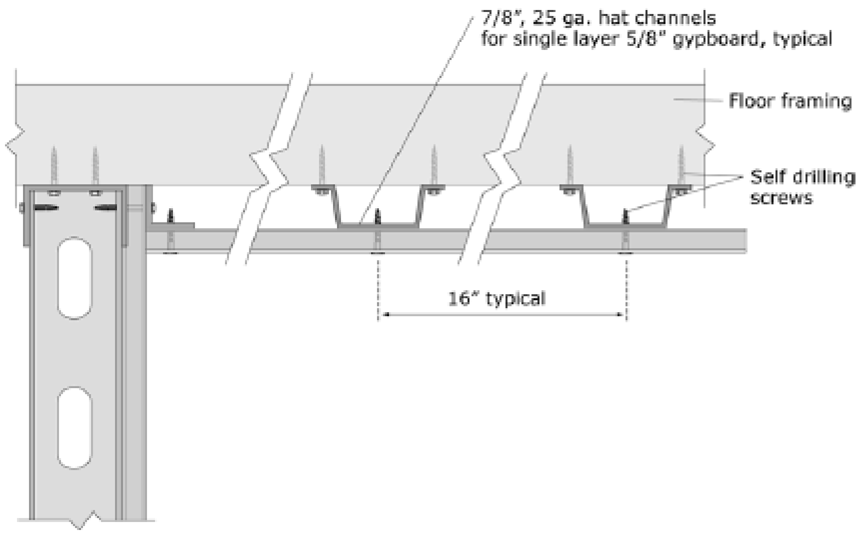


Figure G-11. Suspension System for Acoustic Lay-in Panel Ceilings – Overhead Attachment Details.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



a) Gypsum board attached directly to ceiling joists



b) Gypsum board attached directly to furring strips (hat channel or similar)

Note: Commonly used details shown; no special seismic details are required as long as furring and gypboard secured. Check for certified assemblies (UL listed, FM approved, etc.) if fire or sound rating required.

Figure G-12. Gypsum Board Ceiling Applied Directly to Structure.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

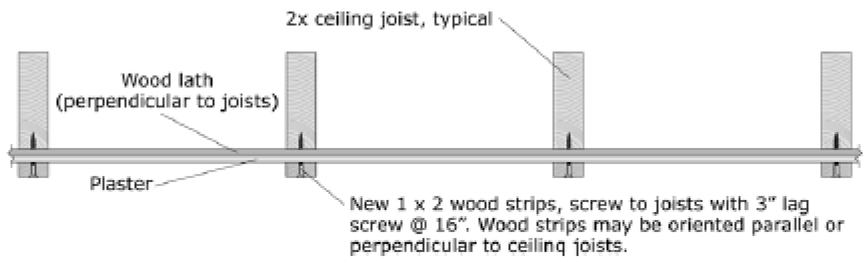


Figure G-13. Retrofit Detail for Existing Lath and Plaster.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

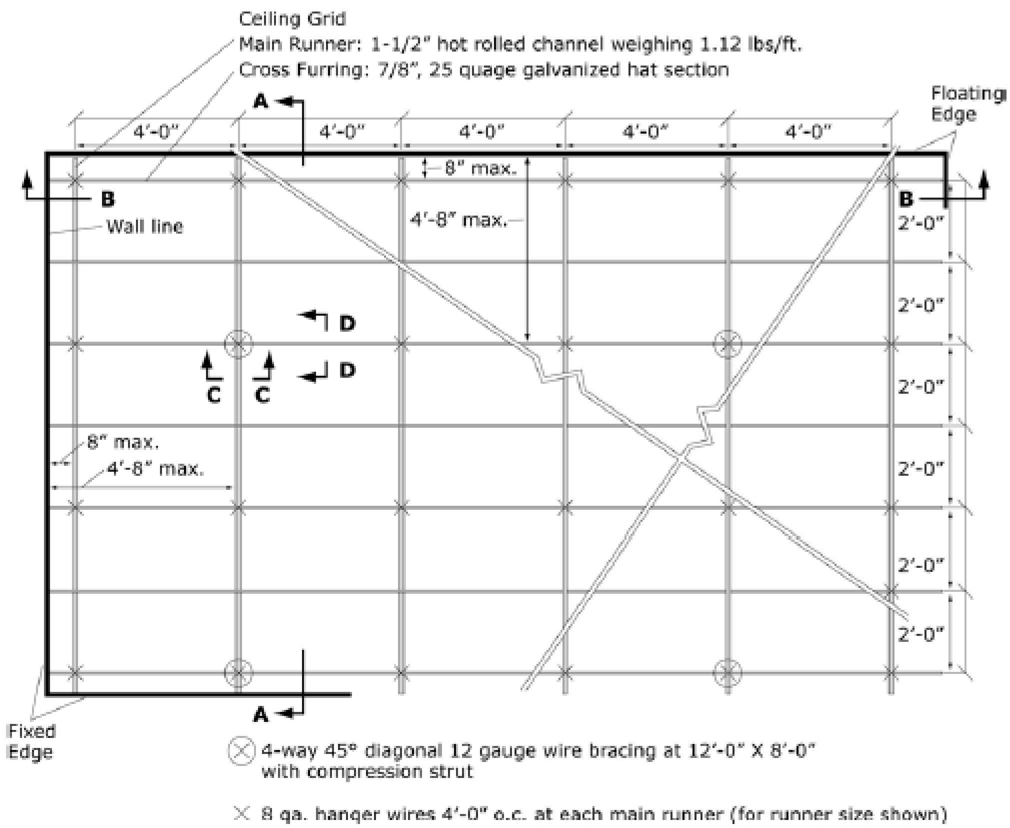


Figure G-14. Diagrammatic View of Suspended Heavy Ceiling Grid and Lateral Bracing.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

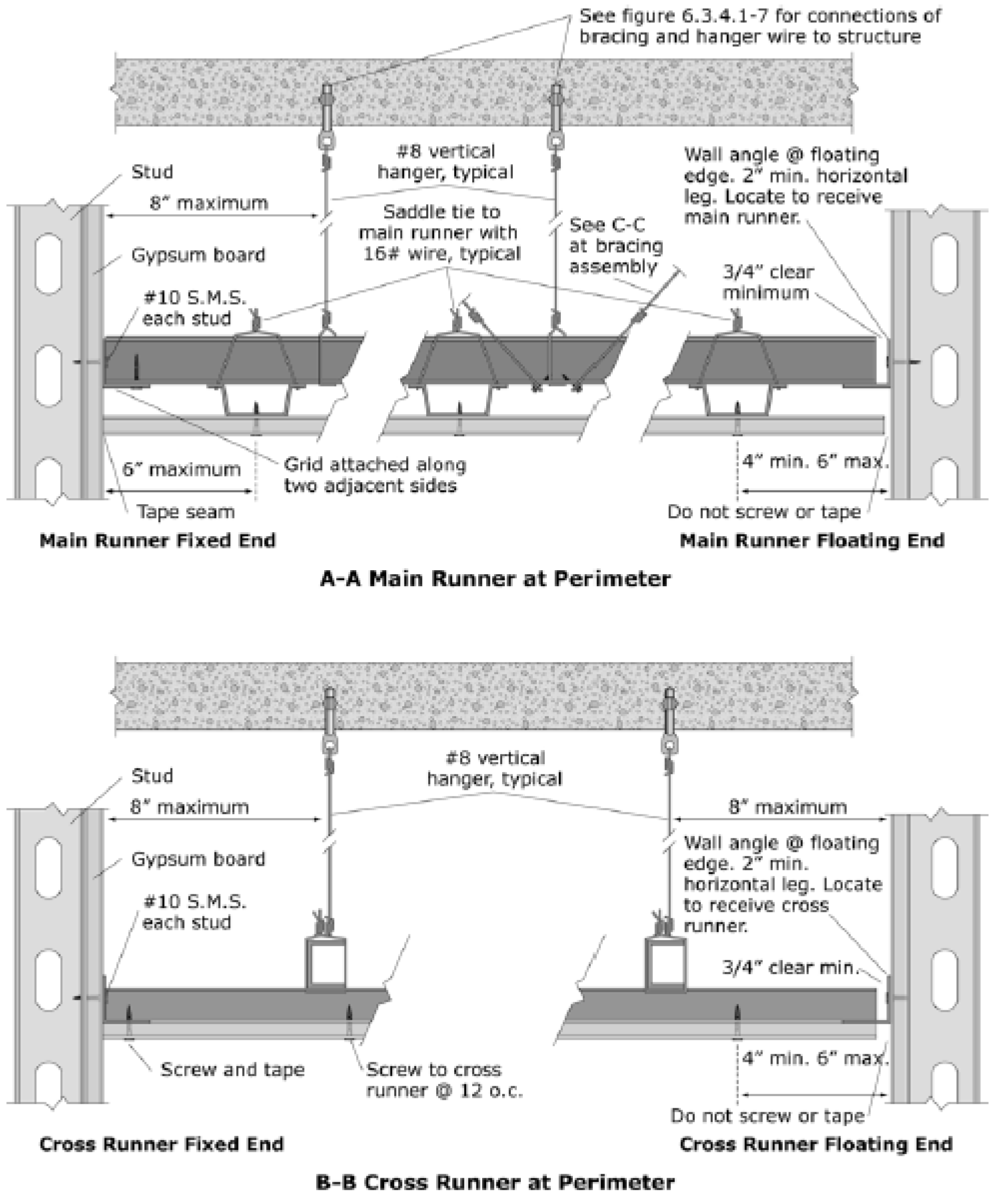


Figure G-15. Perimeter Details for Suspended Gypsum Board Ceiling.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

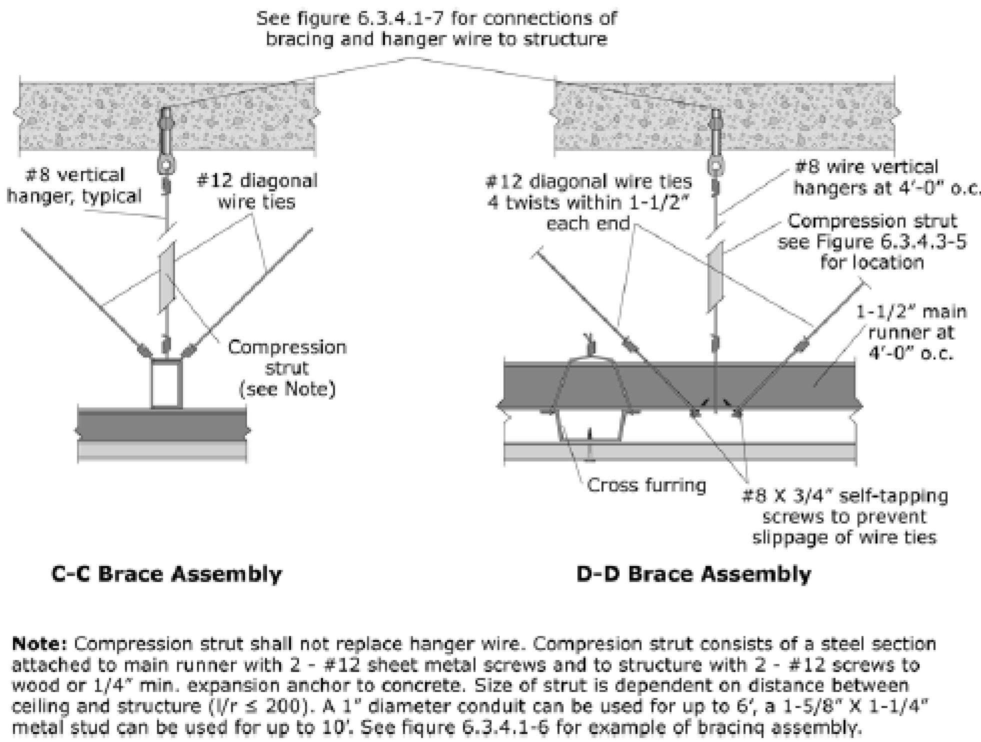


Figure G-16. Details for Lateral Bracing Assembly for Suspended Gypsum Board Ceiling.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

Light Fixtures

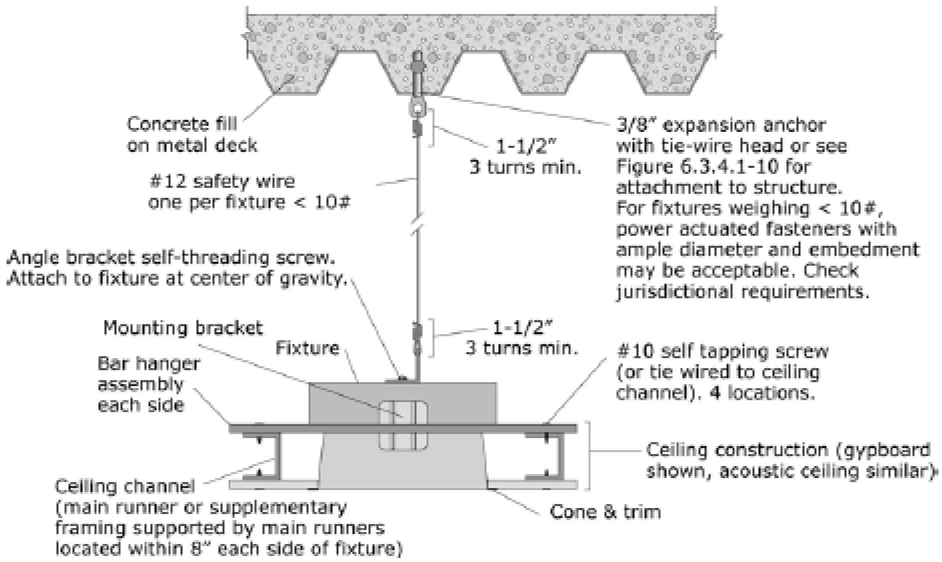


Figure G-17. Recessed Light Fixture in suspended Ceiling (Fixture Weight < 10 pounds).

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

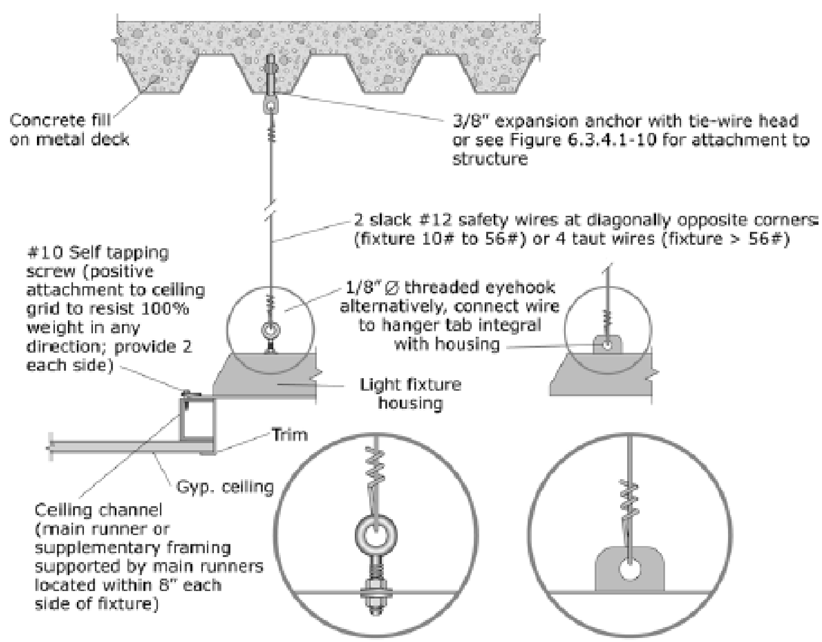


Figure G-18. Recessed Light Fixture in suspended Ceiling (Fixture Weight 10 to 56 pounds).

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

Contents and Furnishings

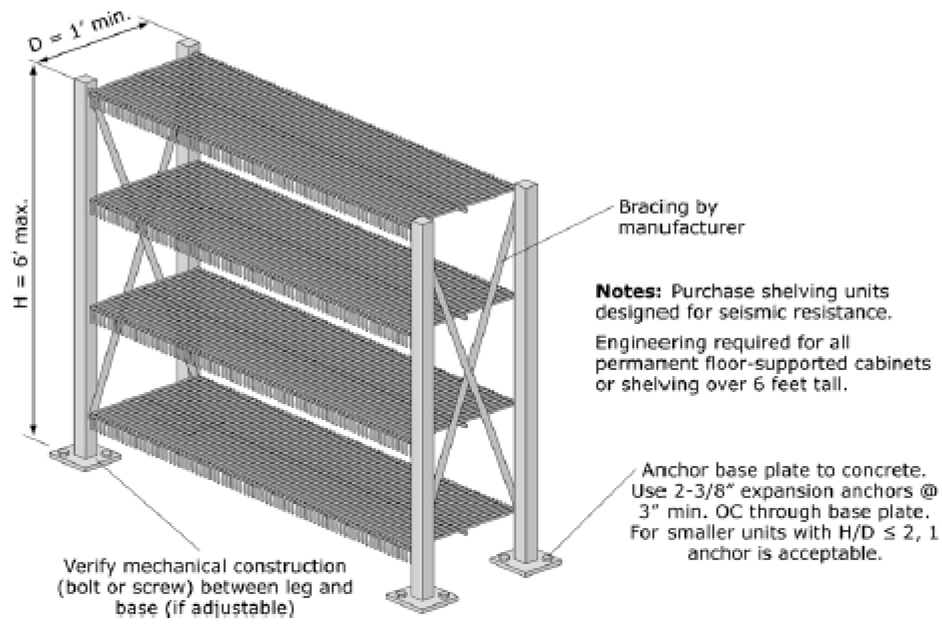


Figure G-19. Light Storage Racks.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

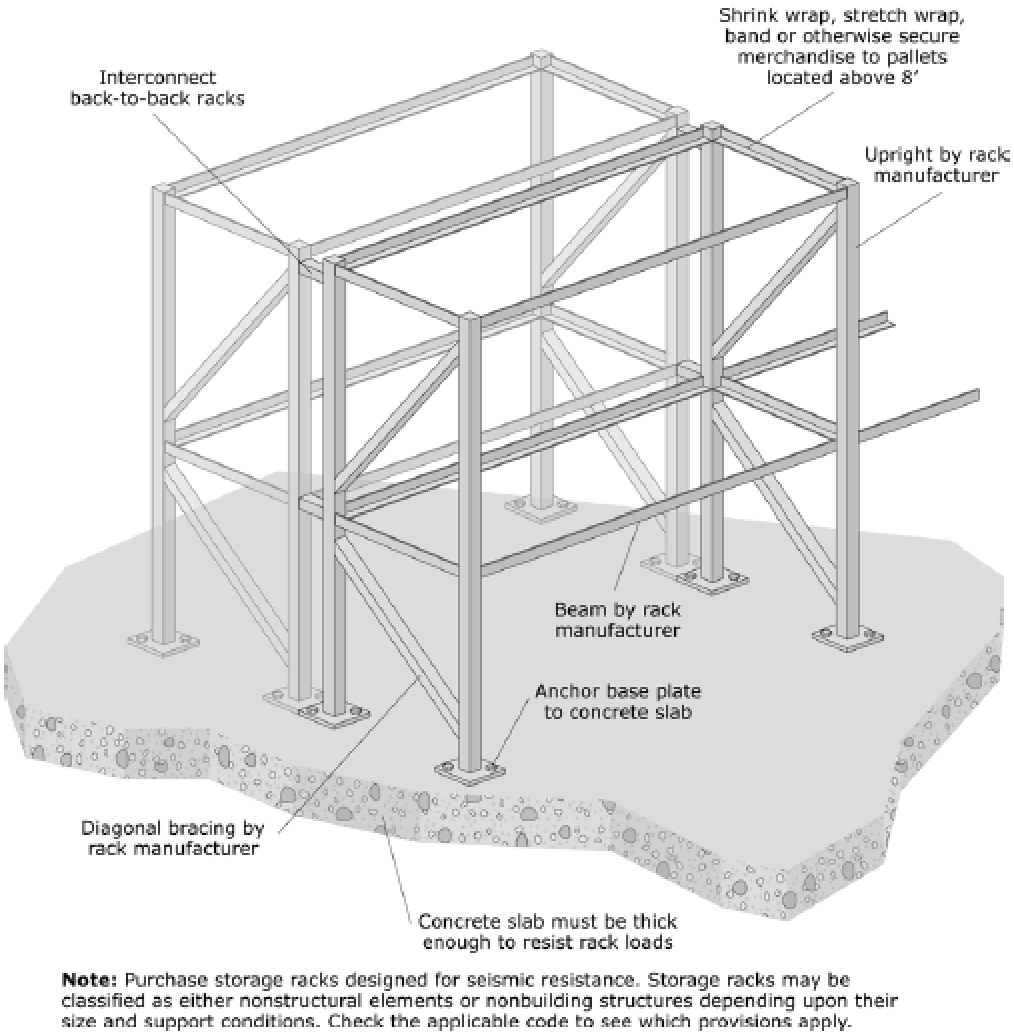


Figure G-20. Industrial Storage Racks.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

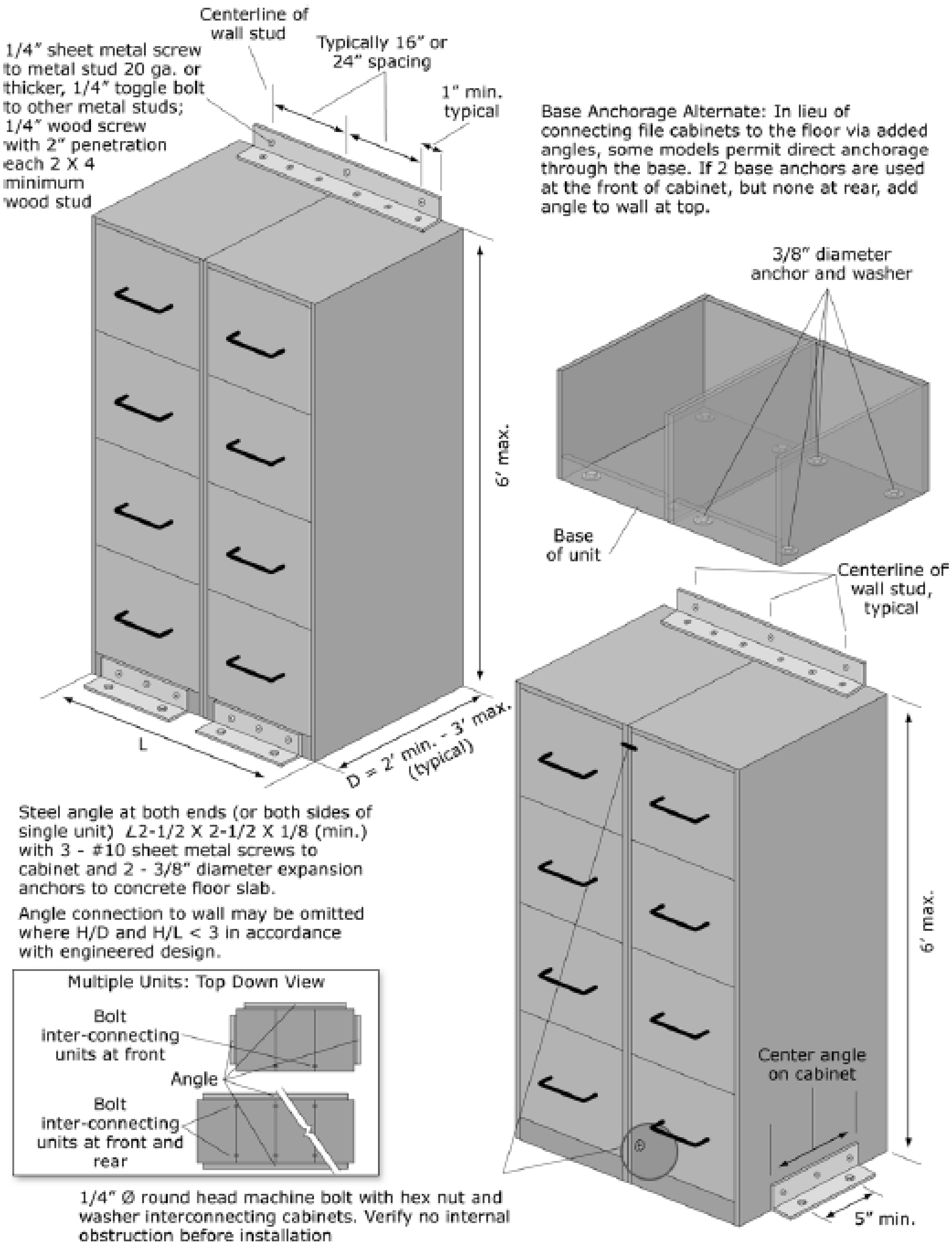


Figure G-21. Wall-mounted File Cabinets.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

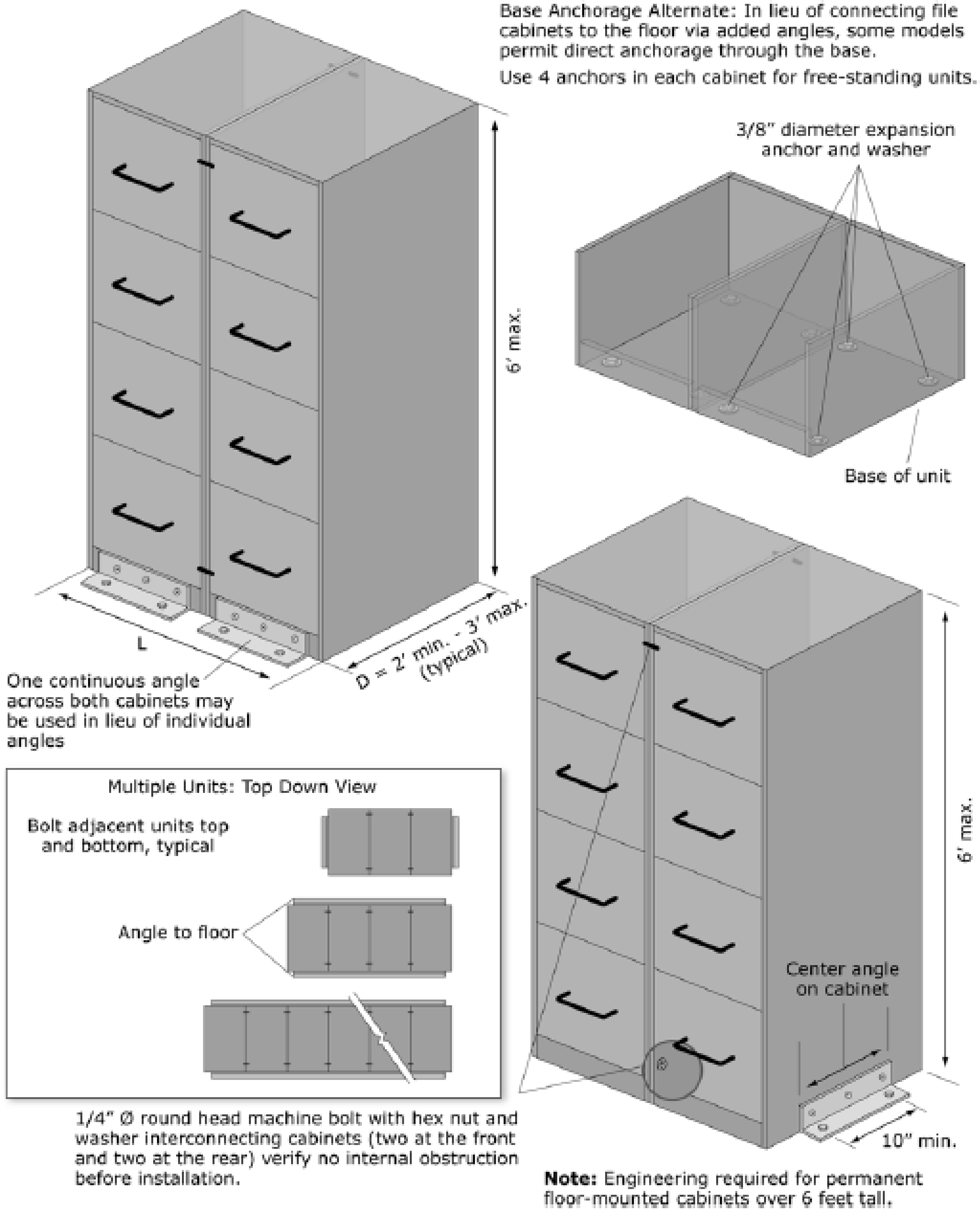


Figure G-22. Base Anchored File Cabinets.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

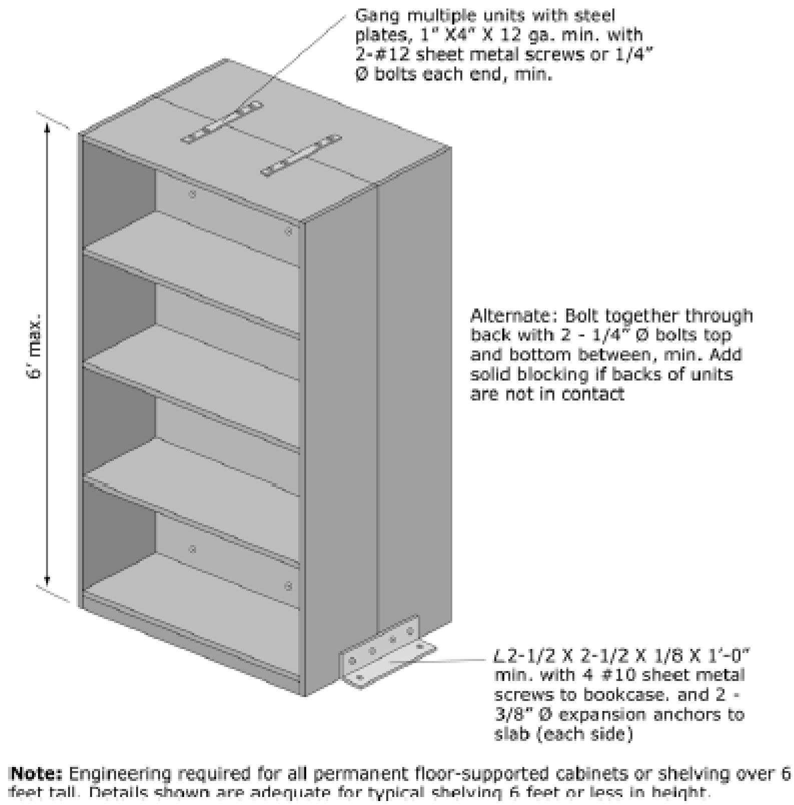


Figure G-23. Anchorage of Freestanding Book Cases Arranged Back to Back.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

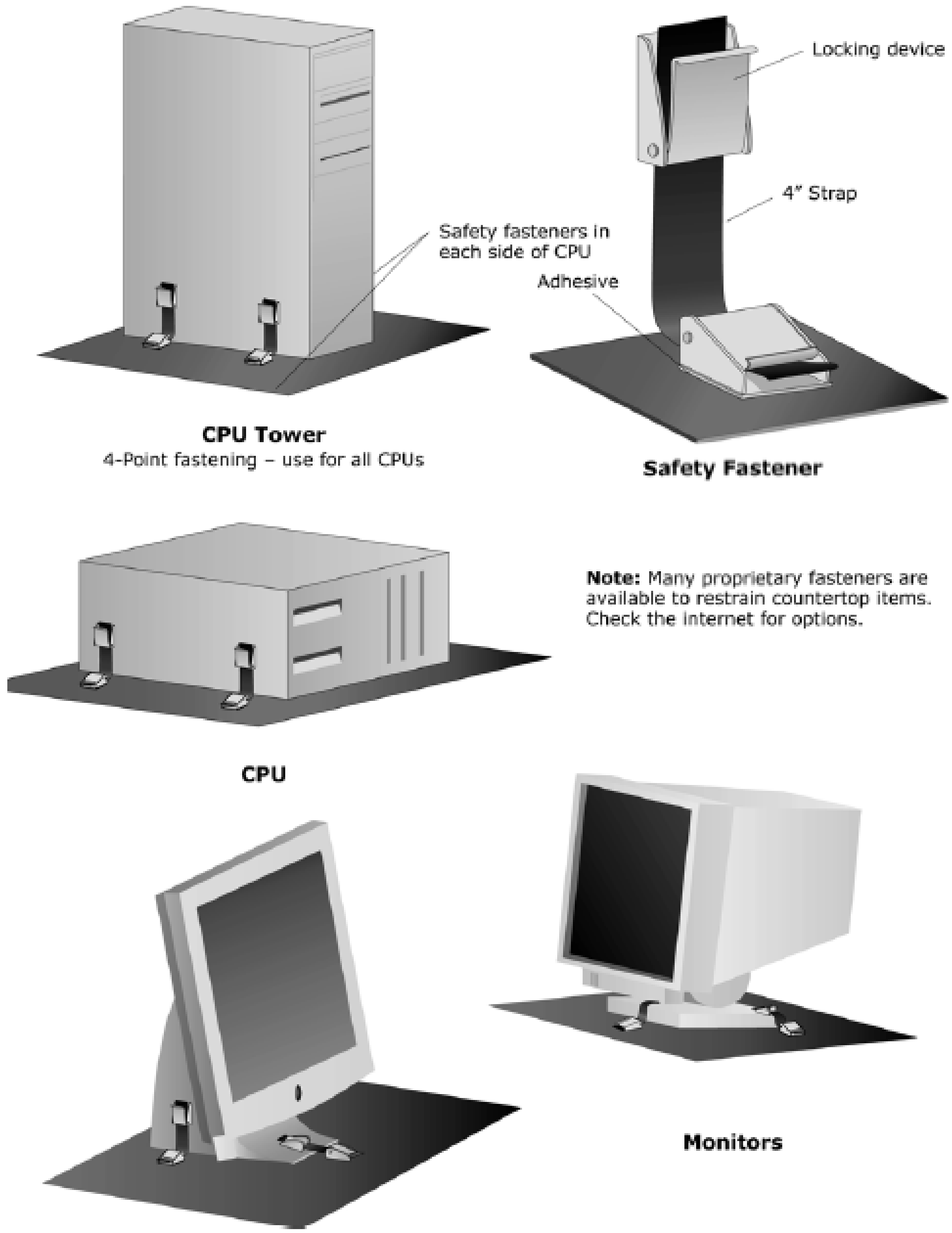
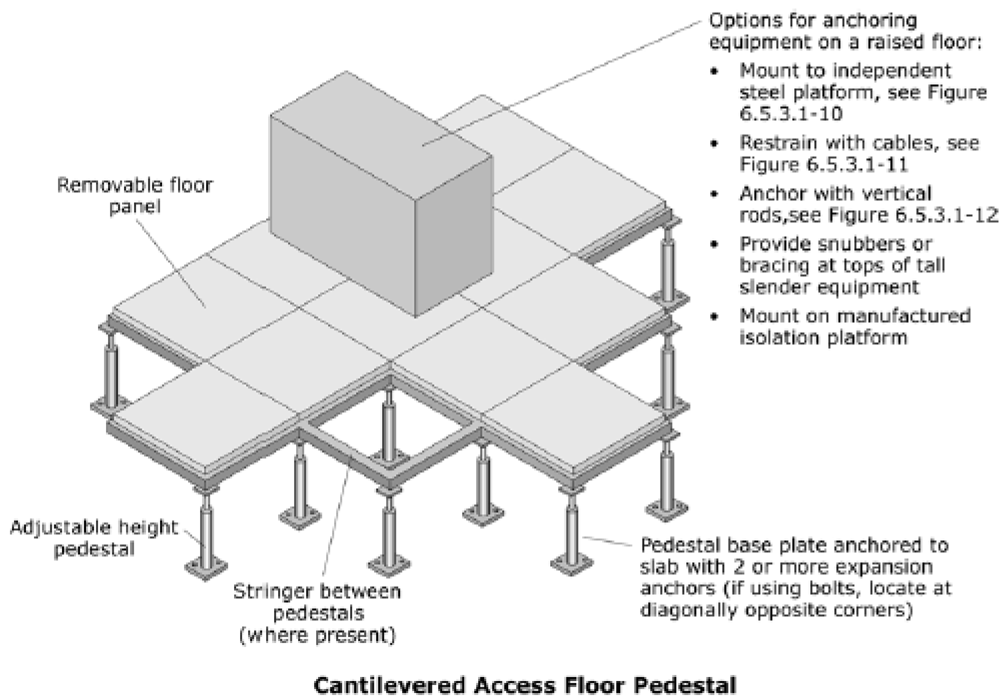


Figure G-24. Desktop Computers and Accessories.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



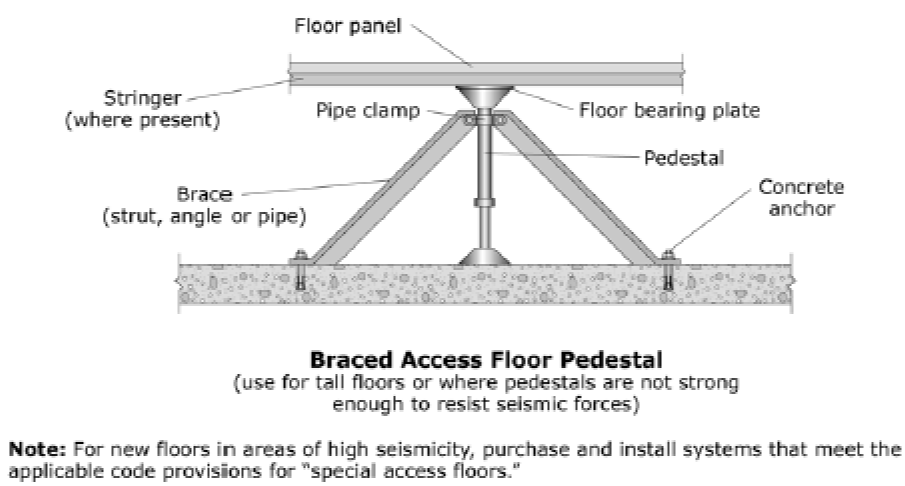


Figure G-25. Equipment Mounted on Access Floor.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

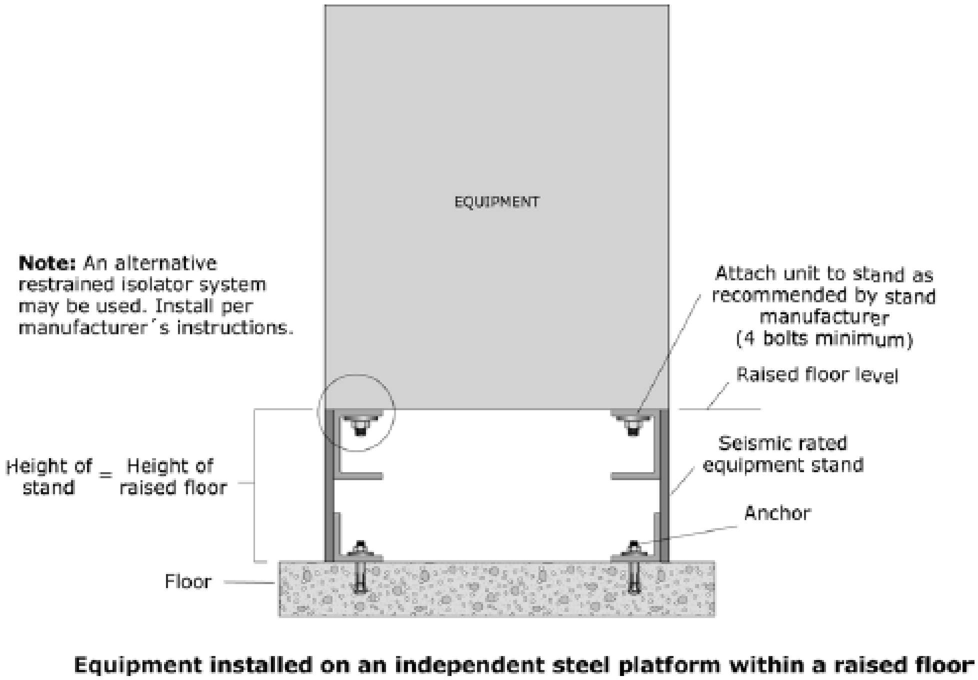


Figure G-26. Equipment Mounted on Access Floor – Independent Base.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

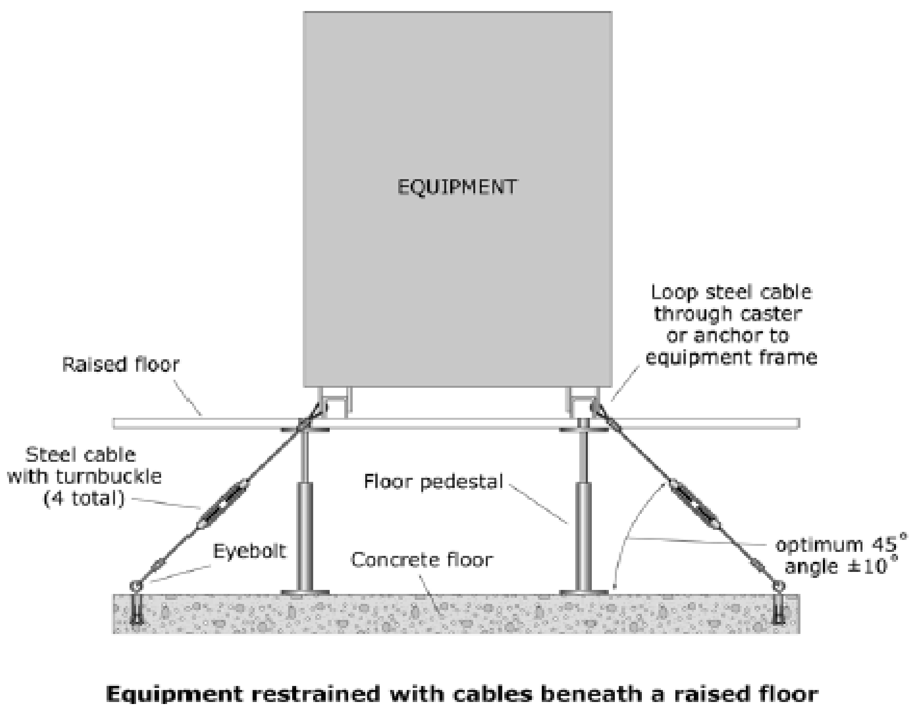
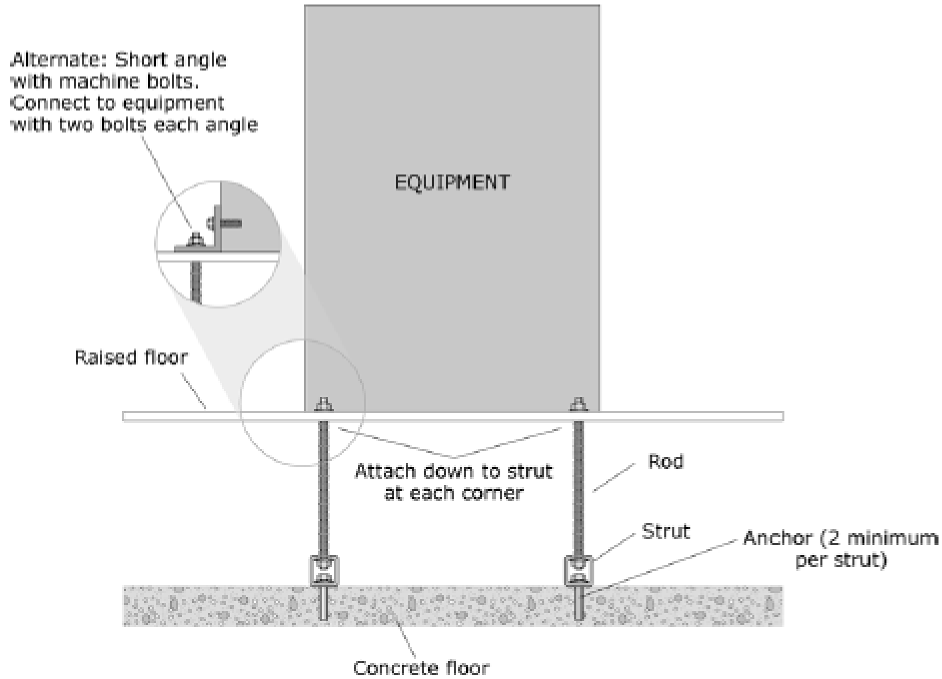


Figure G-27. Equipment Mounted on Access Floor – Cable Braced.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

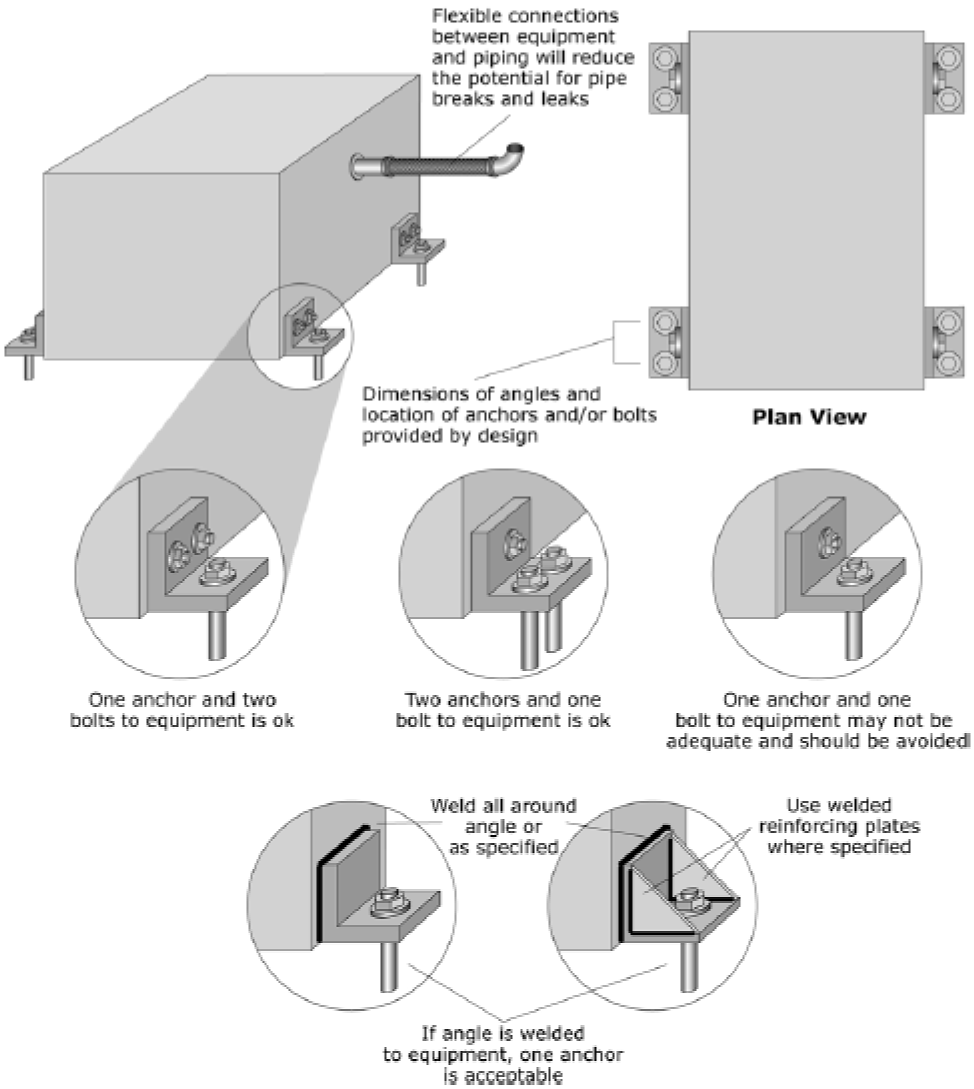


Equipment anchored with vertical rods beneath a raised floor

Figure G-28. Equipment Mounted on Access Floor – Tie-down Rods.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

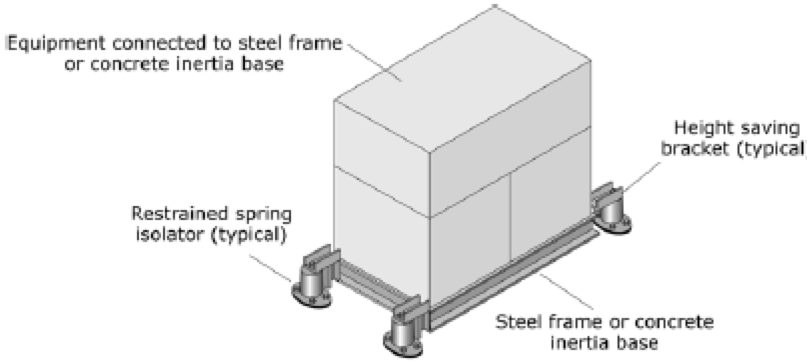
Mechanical and Electrical Equipment



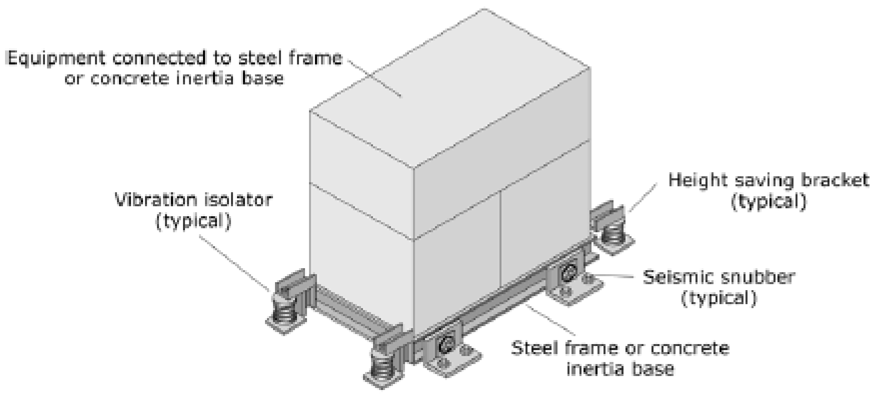
Note: Rigidly mounted equipment shall have flexible connections for the fuel lines and piping.

Figure G-29. Rigidly Floor-mounted Equipment with Added Angles.

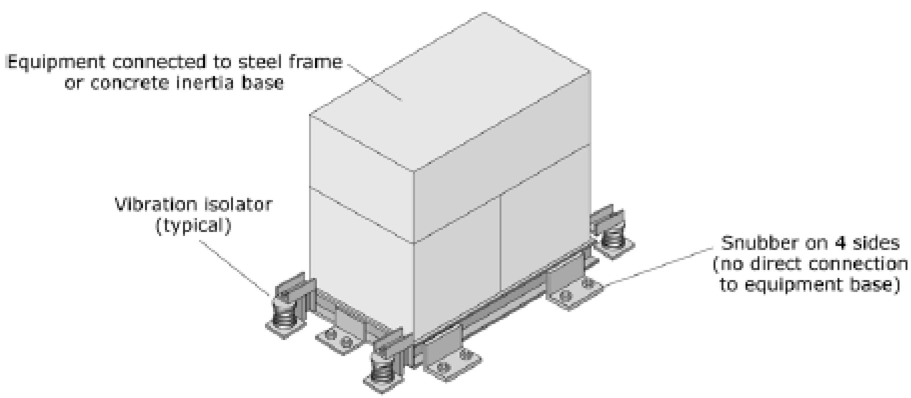
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



Supplemental base with restrained spring isolators



Supplemental base with open springs and all-directional snubbers



Supplemental base with open springs and one-directional snubbers

Figure G-30. HVAC Equipment with Vibration Isolation.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

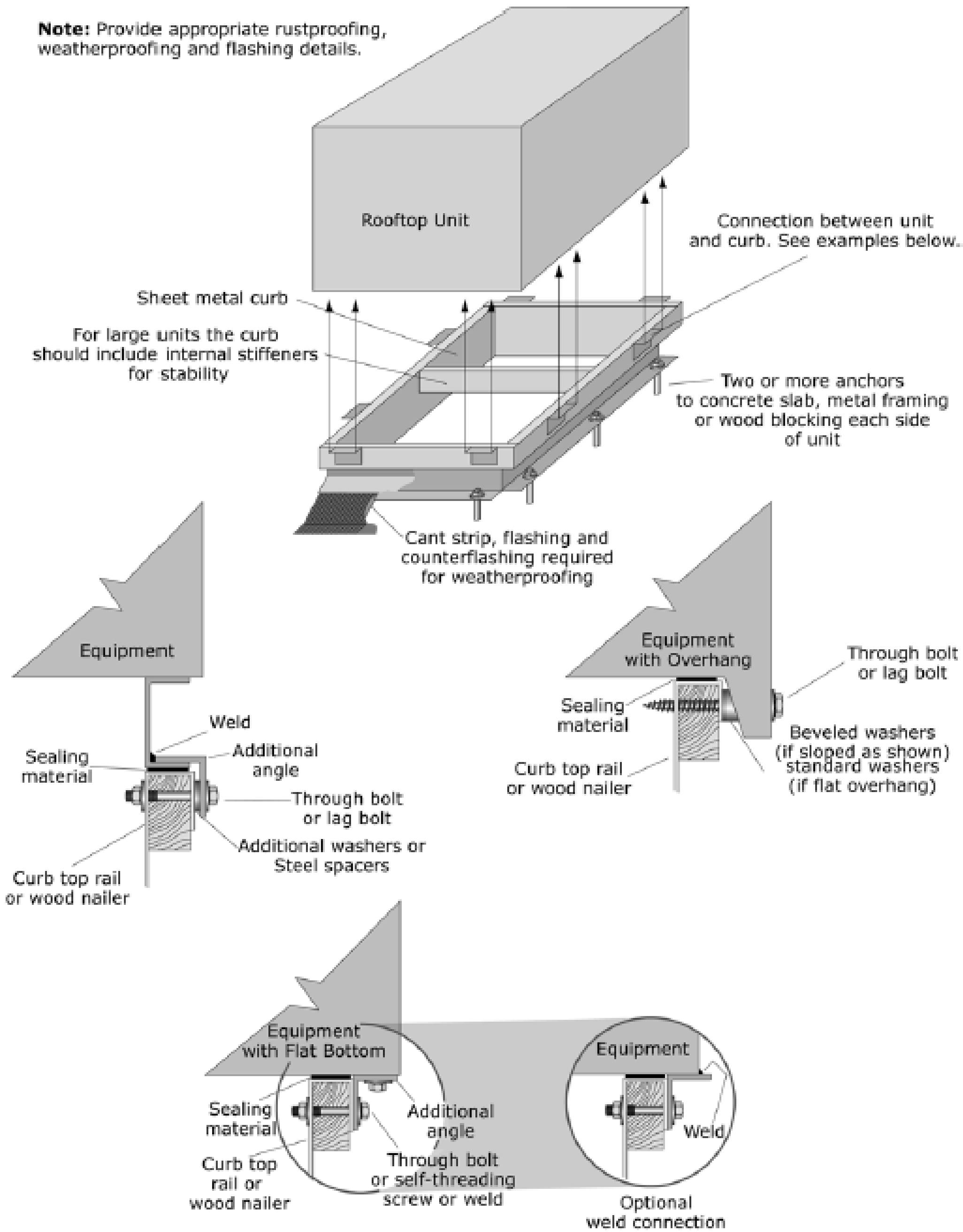


Figure G-31. Rooftop HVAC Equipment.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

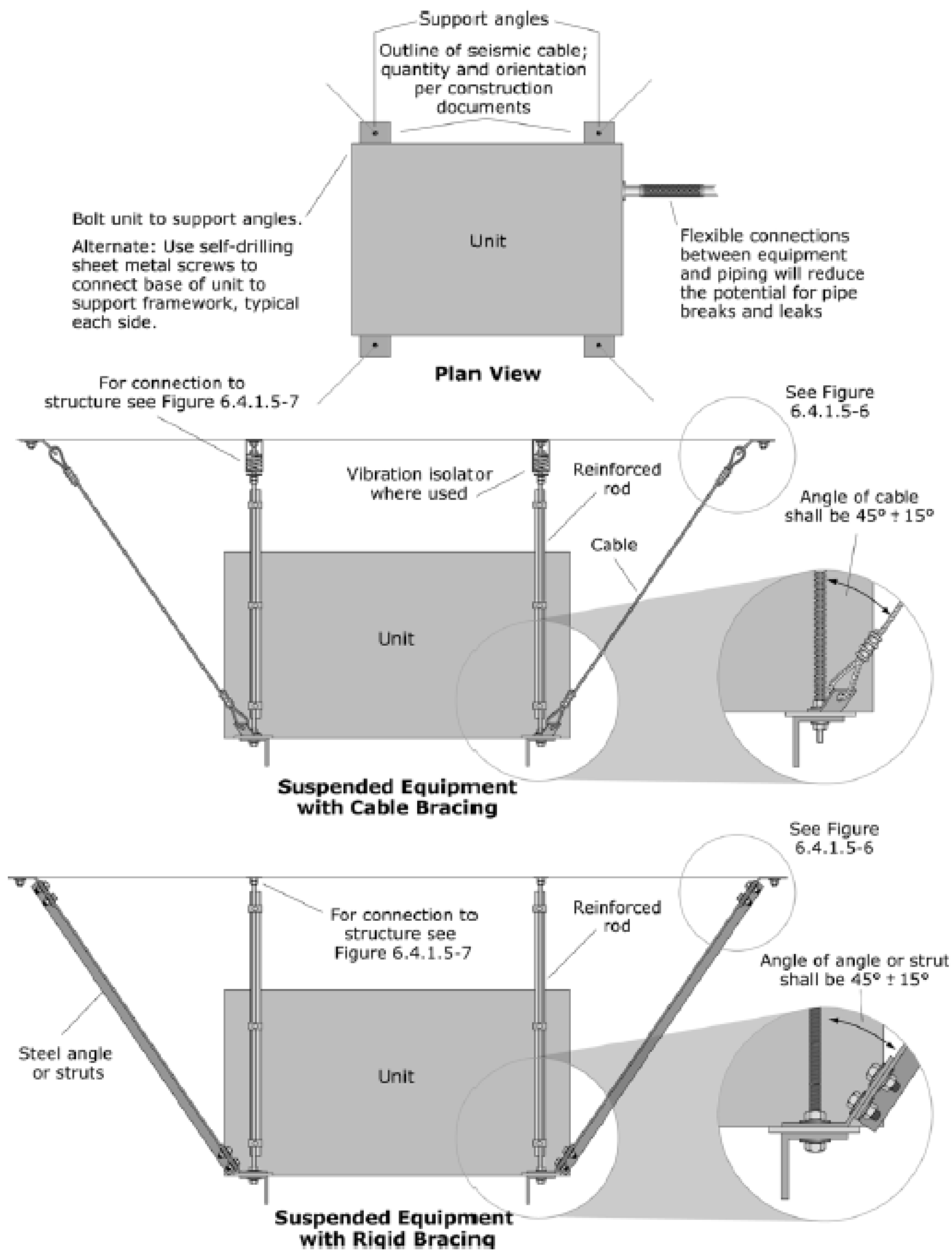


Figure G-32. Suspended Equipment.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

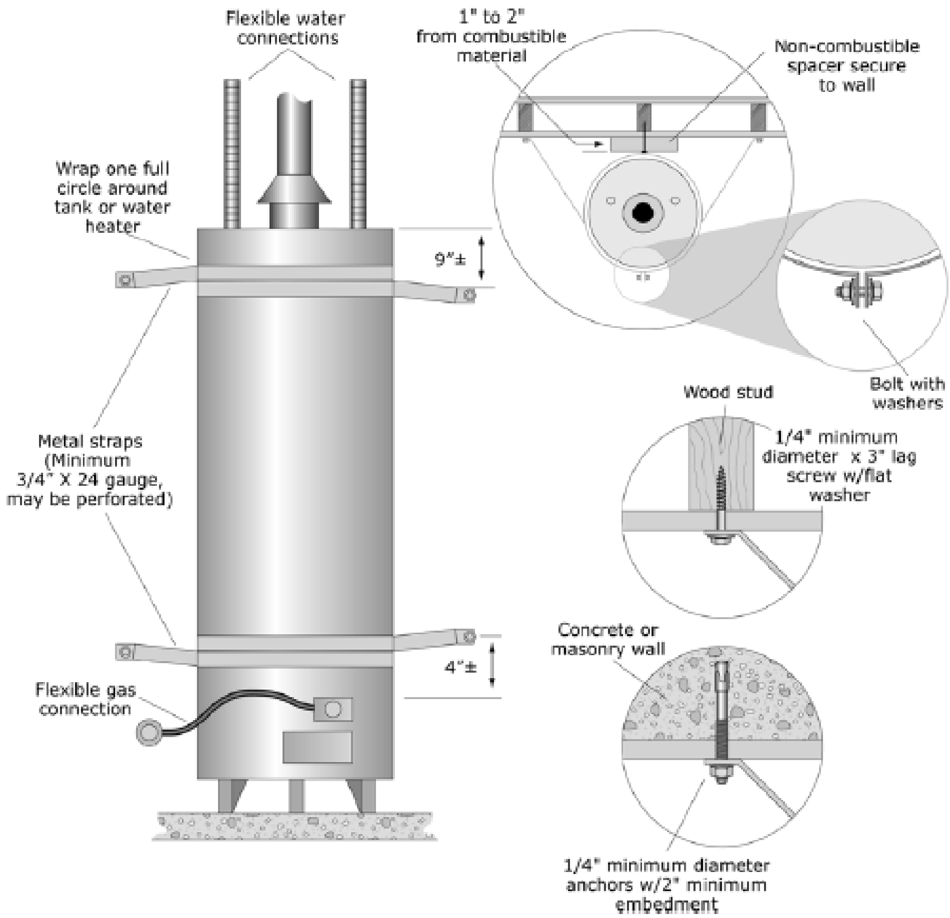


Figure G-33. Water Heater Strapping to Backing Wall.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

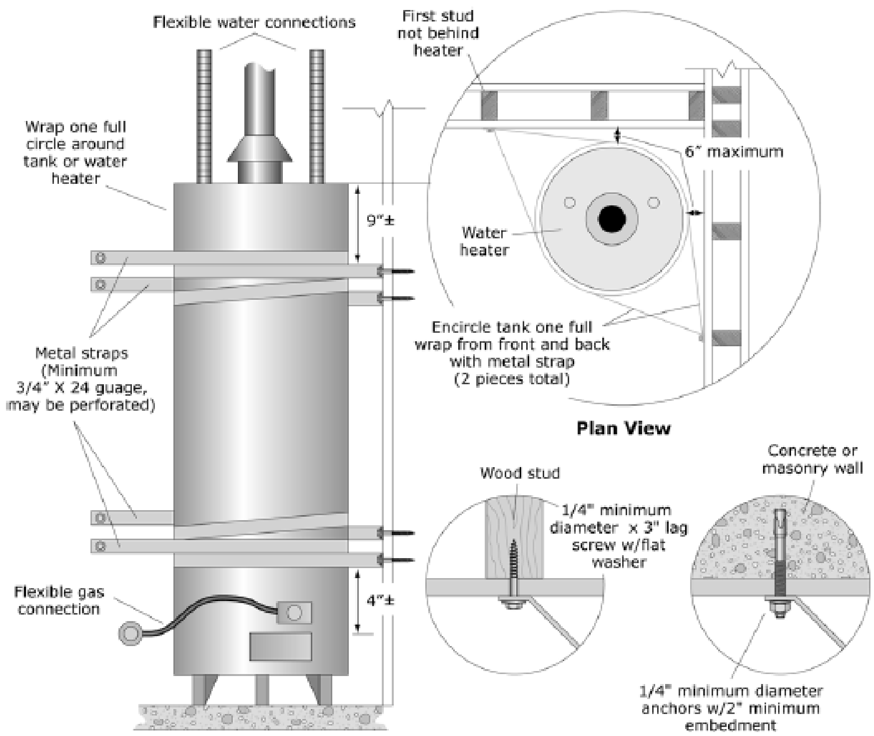


Figure G-34. Water Heater – Strapping at Corner Installation.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

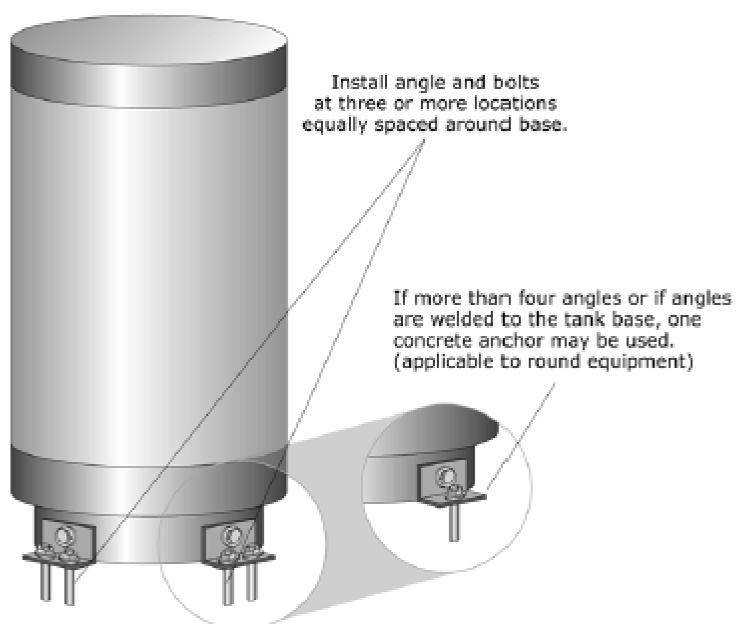


Figure G-35. Water Heater – Base Mounted.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

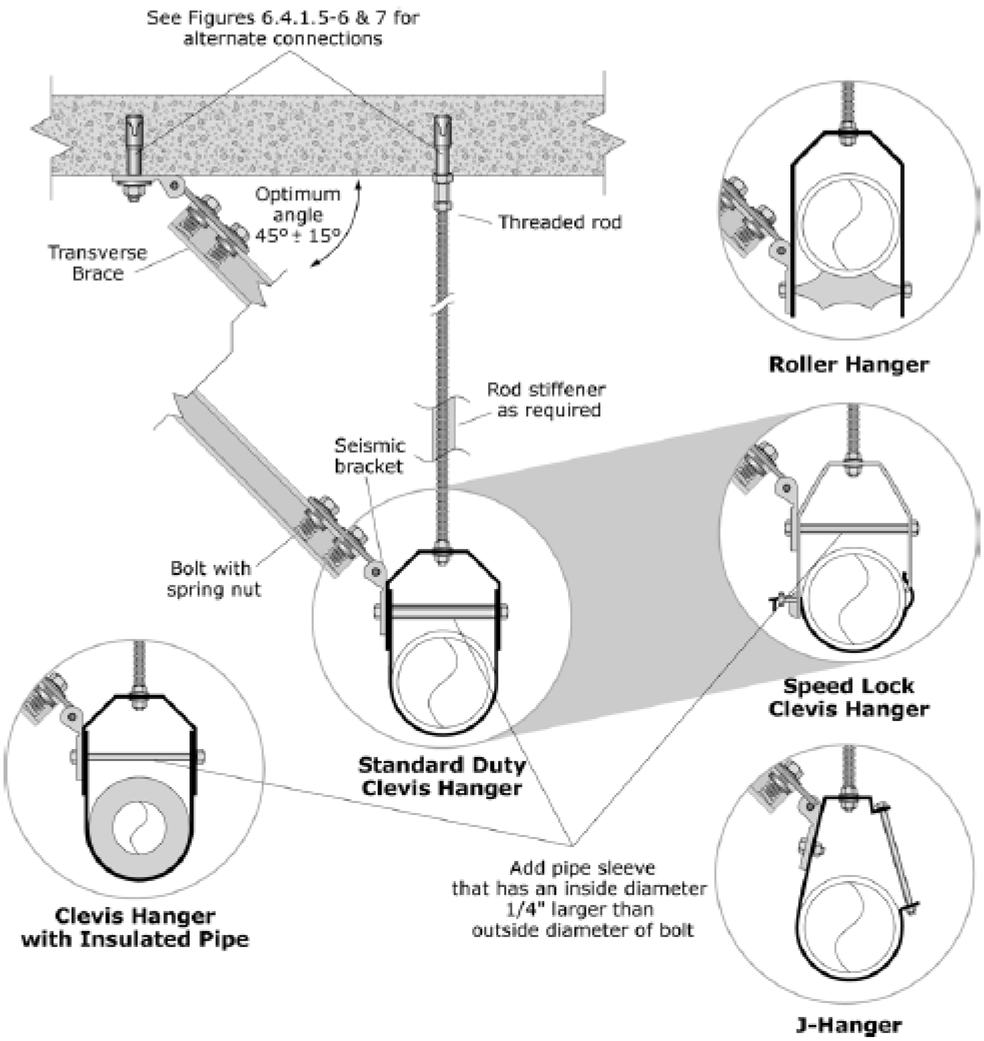


Figure G-36. Rigid Bracing – Single Pipe Transverse.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

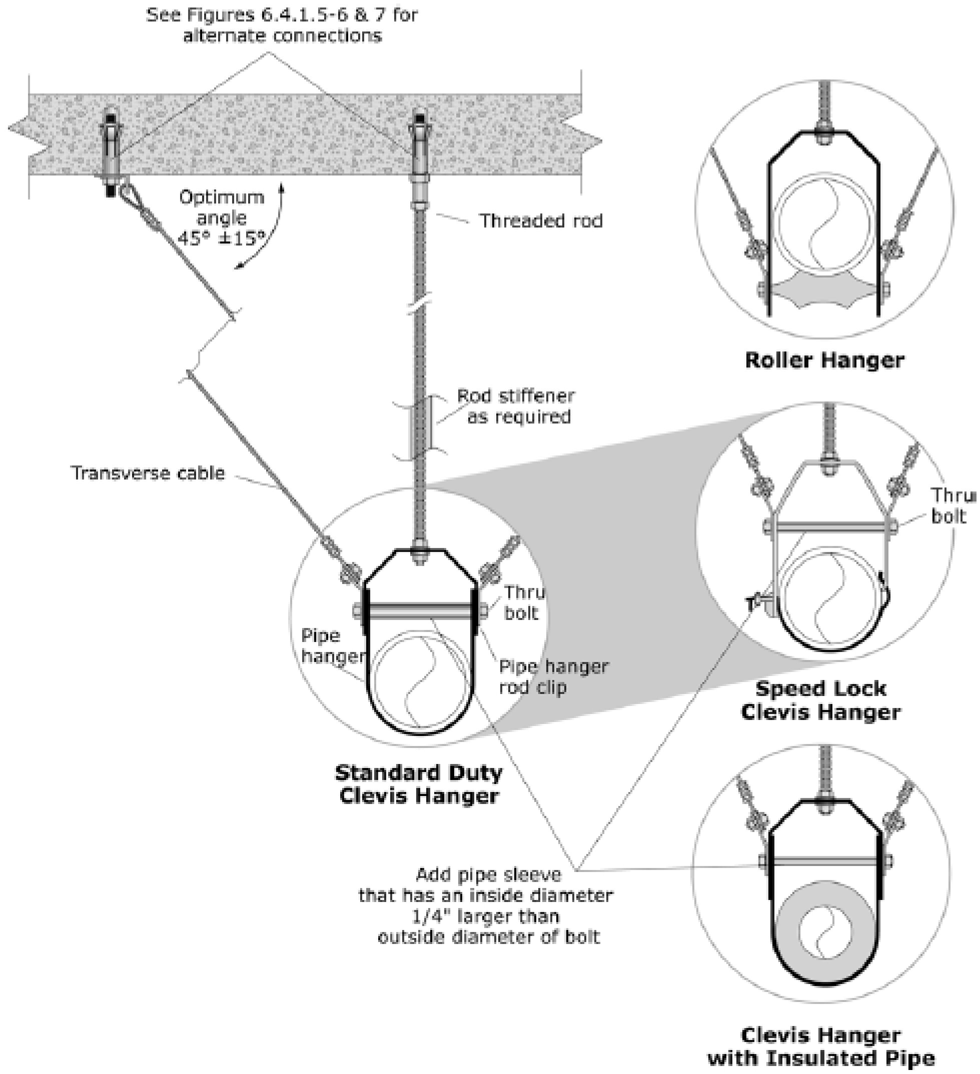


Figure G-37. Cable Bracing – Single Pipe Transverse.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

Electrical and Communications

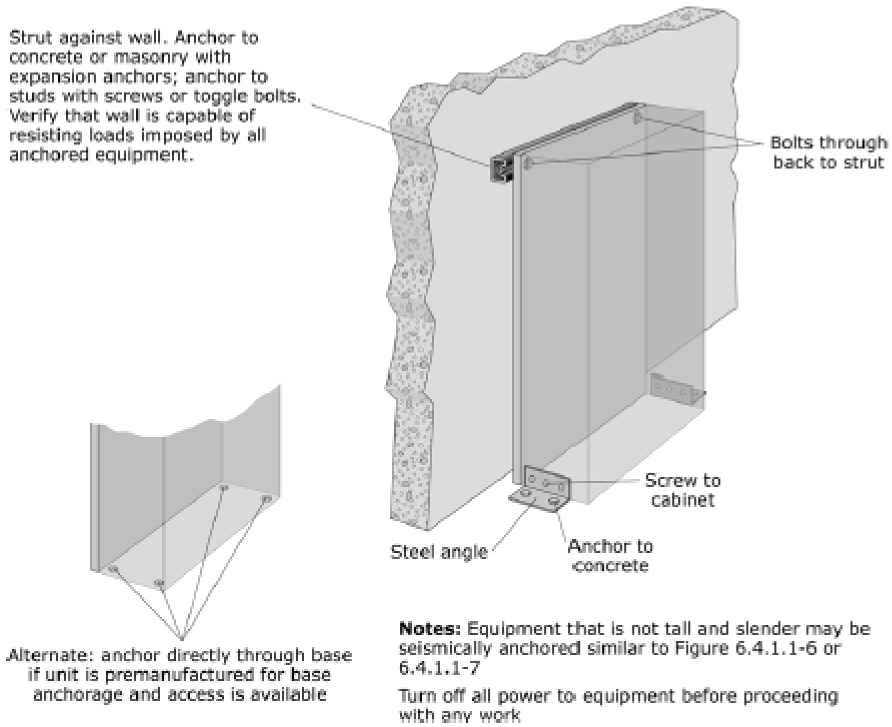


Figure G-38. Electrical Control Panels, Motor Controls Centers, or Switchgear.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

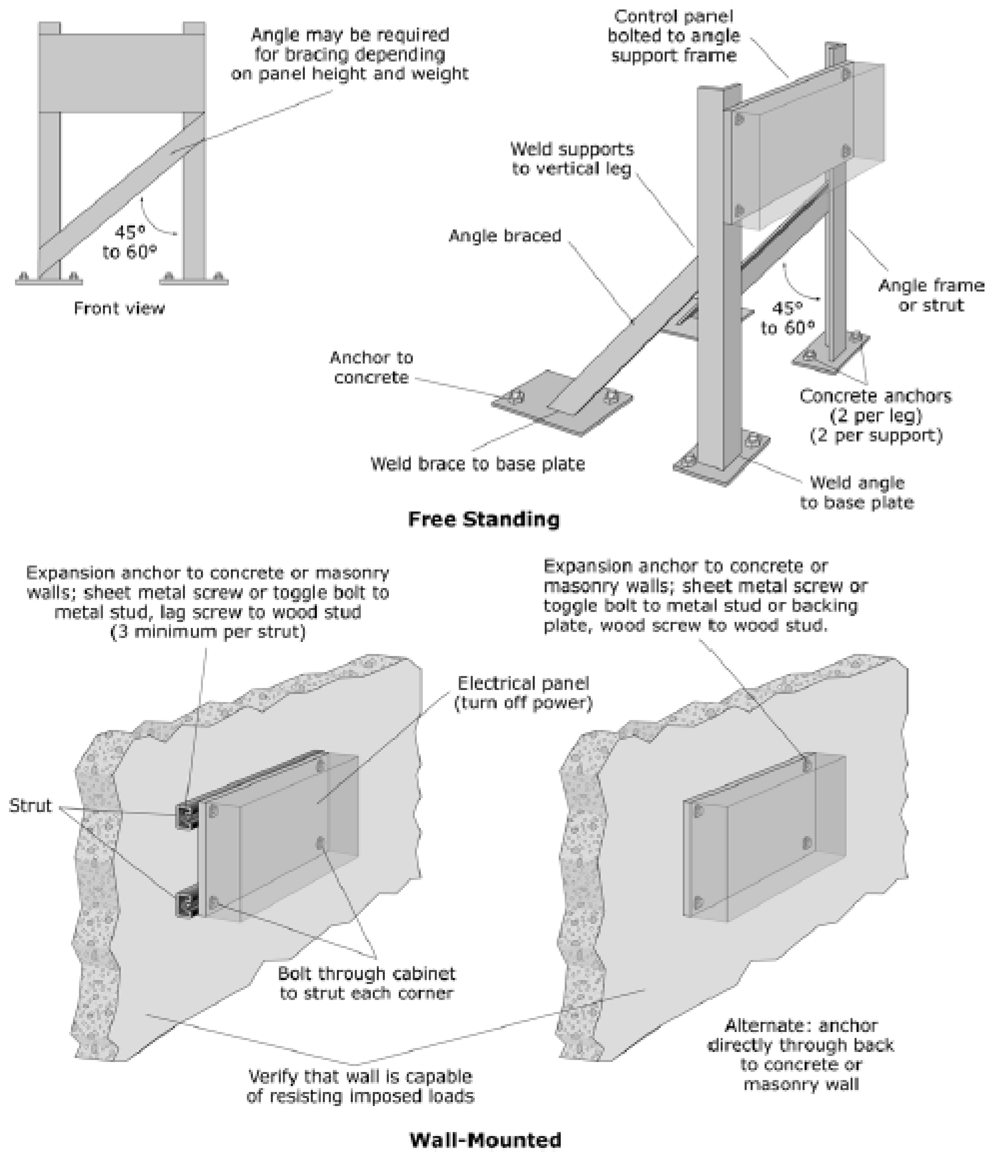


Figure G-39. Freestanding and Wall-mounted Electrical Control Panels, Motor Controls Centers, or Switchgear.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

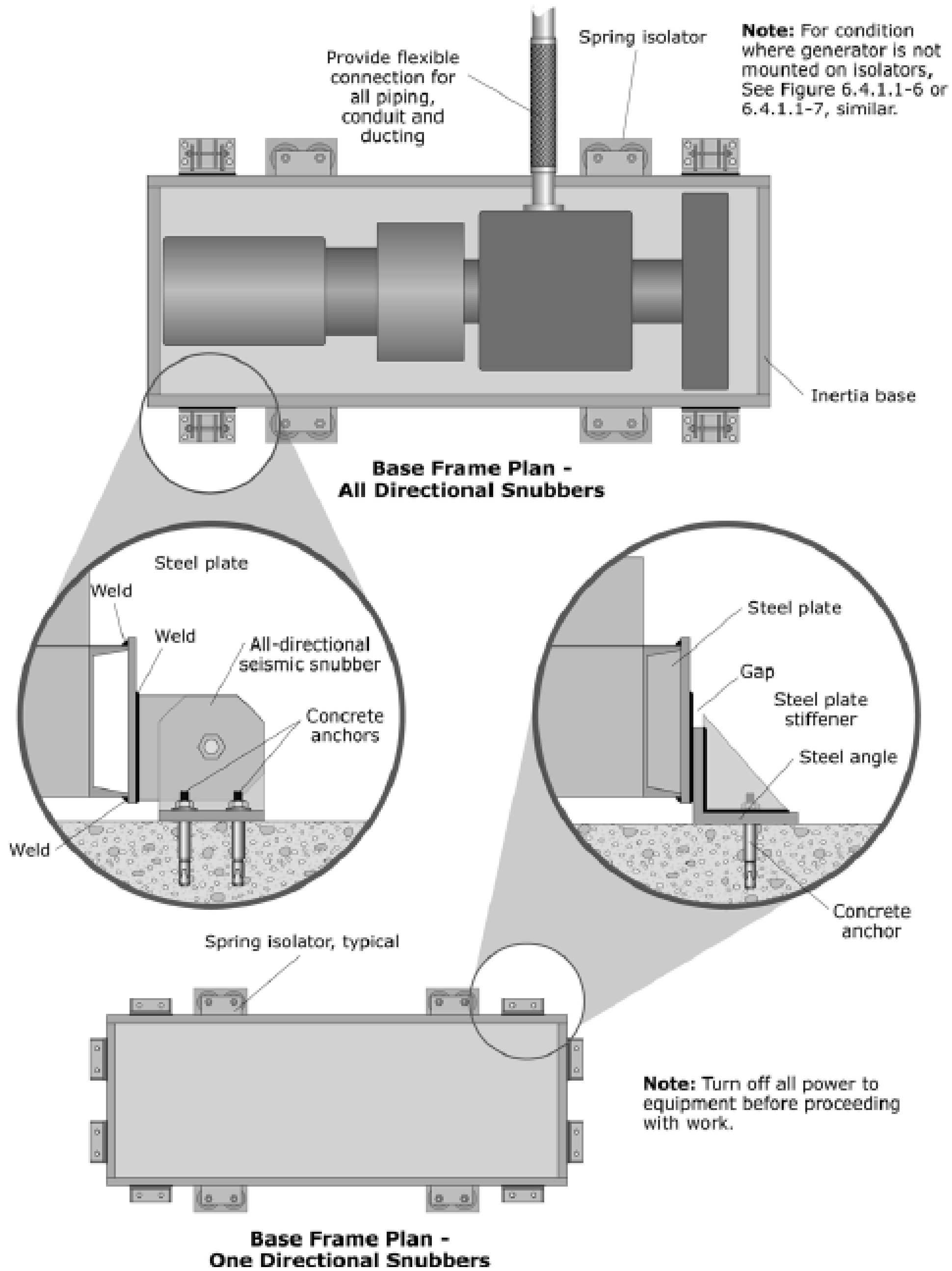


Figure G-40. Emergency Generator.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)